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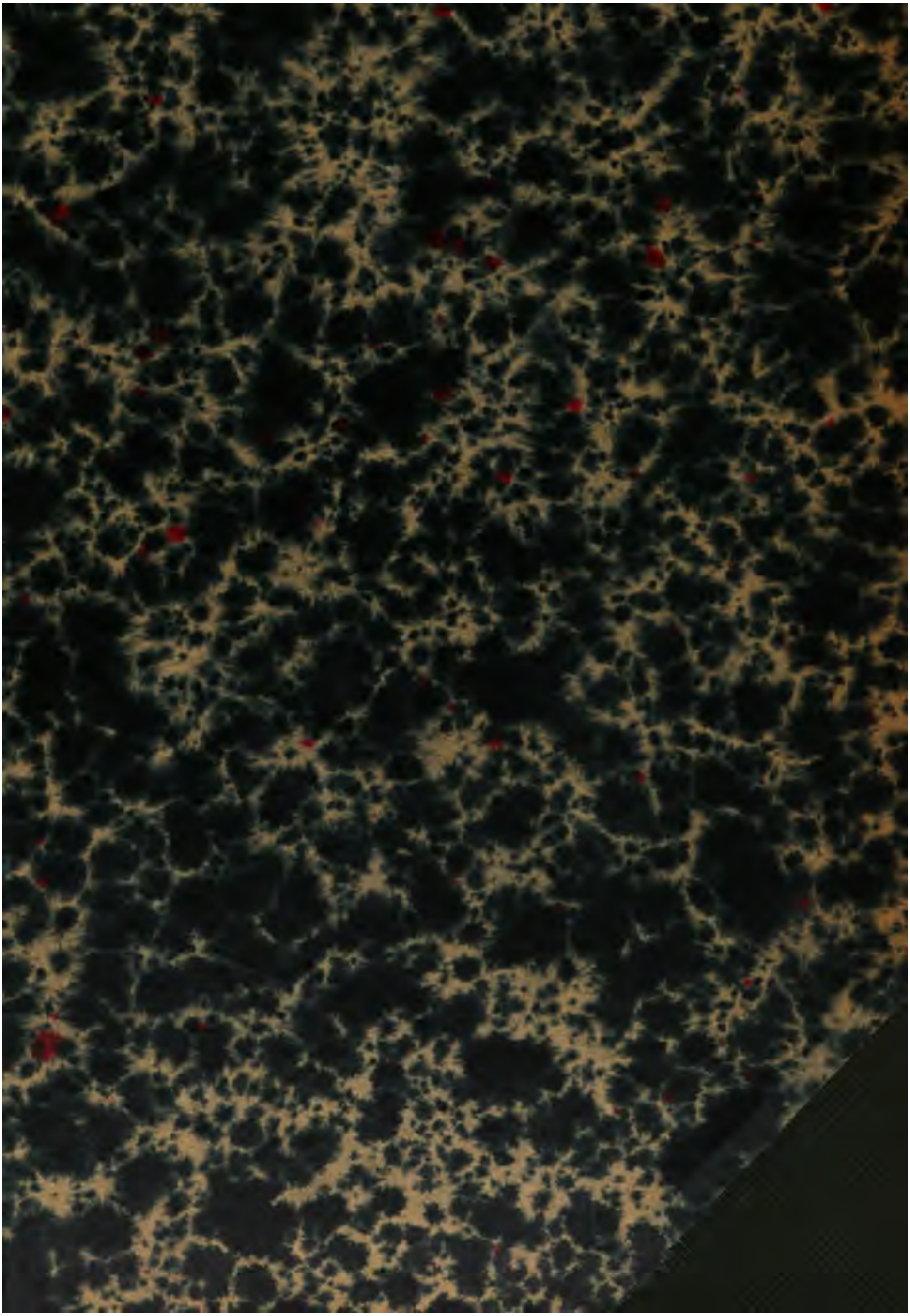

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ERRATA

Title page to No. 5. Read Azal*e*a instead Azal*l*a.

Title page to No. 5. Read Zorotypus hubbard*i* instead Zorotypus hubbardi*s*.

Page 91, line 8 from top. Read S*i*lvestri instead S*y*lvestri.

Page 91, line 10 from top. Read S*i*lvestri instead S*y*lvestri.

Page 98, line 2 from top. Read Zorotypus hubbard*i* instead Zorotypus hubbard*is*.

Page 103, line 3 from bottom. Read c*l*osely instead c*o*lsely.

Page 152, line 7 from bottom. Read Metamasi*us* instead Metamasi*ns*.

Page 156, line 10 from top. Read Callidium *sequoiarum* instead Callidum *sequarium*.

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THE COLONIZING REPRODUCTIVE ADULTS OF TERMITES.

BY THOMAS ELLIOTT SNYDER, *Bureau of Entomology.*

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Introduction.

Interest is always attracted by unusual flights of any animals, whether birds or the less conspicuous insects. In tropical countries, even to the scientist, there is almost an element of magic attendant upon a termite swarm. Apertures are opened in the ground or parent colony mound and suddenly the air is alive with fluttering winged hordes which emerge from these exits. After the flight, the holes are closed from within by workers and all trace of life disappears as suddenly as it appeared. The only evidence of the swarm is the discarded wings lying upon the ground.

Every year the Department of Agriculture receives numerous requests from householders in the United States for information in regard to "flying ants" in buildings. These so-called flying ants are in reality colonizing male and female adult termites, which leave the parent nest or colony in the woodwork of the building and fly or "swarm" in large numbers for the purpose of establishing new colonies. Similar swarms may be observed issuing from colonies in decaying stumps and logs in the forest on warm sunny days.

It is not known what causes this annual swarm or exodus of the winged adults. Possibly they are impelled to leave the parent colony by some instinct, as by the call of sex, or there may be a "spirit of the colony" similar to that which Maeterlinck so aptly described in "The Life of the Bee" (1904) as the "spirit of the hive." It is not the queen honey bee who rules the hive and induces the swarm of queen, drones and workers, but this elusive "spirit of the hive," evidenced in the assembly of the workers, which are said to have the larger brain. In the case of the termites, however, the winged males and females—which alone swarm—have a far larger brain than the worker, Thompson (1916). This "spirit of the colony" in termites may be merely the result of such a stimulus as body odor perceived by contact, which, according to Beebe (1919), is probably the governing factor in establishing routes of travel by army ants in the tropics.

The winged termite is not the only colonizing reproductive form. Although the most striking form and the one that has in the past received the most attention from entomologists, there are other less conspicuous reproductive forms which are also important to the termite colony. The two most common of these other reproductive types will be described in some detail and mention will also be made of "intermediate" forms.

The following pages will discuss the occurrences of these different colonizing reproductive forms in colonies, their origin, development, and the manner in which each type establishes new colonies—regarding which, except in case of the winged adult, but little is known. The progeny of the different reproductive forms will also be described. A brief account of attempts at cross breeding between two different types of reproductive forms will be given.

The Three Types of Reproductive Forms.

In addition to the normal, pigmented, winged reproductive forms that engage in this colonizing flight, there are two other stable reproductive types. The more or less darkly pigmented body, functional eyes, and aerial habit in colonizing (*i. e.*, swarming) are found only in adults of the first form; after fertilization they attain the greatest post-adult size. In general, there is a subterranean mode of life, less body pigment, and smaller eyes in the second and third form, the former caste having short wing-pads, the latter being entirely apterous and worker-like.

A brief descriptive comparison of the three different reproductive forms will be necessary before the manner in which new colonies are established can be described.

Description of the Adults of the First Form of Species of Reticulitermes Holmgren.

The winged, sexual adults of the first form are deeply pigmented, the compound eyes are pigmented and functional; this caste is especially adapted for flight and is capable of enduring full sunlight. Lightness of body for the colonizing flight is a primary necessity and the admirable manner in which this has been attained may be seen upon comparison with the other reproductive forms—particularly in the more slender thorax, mouthparts and legs.

"Stylets" or abdominal appendices on the ventral surface of the 9th abdominal segment of the female are absent, disappearing during the final nymphal molt.

At the time of the annual swarm the sex organs of this form are not ready to function.

After this flight and deälation, unlike most insects, the young parent adults feed and there is an actual "post-adult" growth; the abdomen of the queen becomes distended, due chiefly to the development of the ovaries; but later there is also a multiplication of cells—fat cells and blood cells. The abdomen of the male or king also becomes slightly increased in size with the later inflation of the body with fat, together with the development of the sex organs. The male of the first (and also the second) reproductive type continues to cohabit with the queen and there is repeated copulation.

Although their abdomens are slightly distended, the males of the first form are very active; they are usually present in the royal cell together with the queen, but, on account of their small size, they frequently escape when the colony is broken into. Sometimes, when escape is shut off, the male will attempt to hide under the greater body of the female but they usually desert their consorts at the first sign of danger.

There is only a single pair in each colony, since first form adults are normally monogamous. Sometimes in incipient colonies there may be—temporarily at least—one male and two females or *vice versa*.

Rarely, a male of the first form has been found in a colony with numerous females of the second form.

"True queens" (of the first form) of our common species were thought either to be very rare or not to exist until quite recently; this idea has been disproved by Joutel (1893), Hubbard and Schwarz (1901), Schaeffer (1902), Heath (1903) and the present writer (1912). A historical account of the first finding of these forms in the United States is given by the writer (1915). In searching for the cell which contains the queen, it must be remembered that its location depends upon the species and the habits of the termite, the geographical locality and its climate, and, in some degree, upon the season of the year. The fact must also be borne in mind that termites have several different types of reproductive forms. The commonest type appears to be the deälated, colonizing, sexual adult, developed from nymphs of the first form, *i. e.*, an adult queen of the first form. Queens of this type reach the largest dimensions—(in species of *Reticulitermes* 14.5 mm. in length). This reproductive form is apparently the parent of all the other reproductive forms as well as of the soldier and worker castes. These reproductive forms of the three types should be considered as distinct castes.

All of these reproductive forms have been described in more detail and figured, (Snyder, 1915 and 1916).

Description of the Adults of the Second Form of Species of Reticulitermes.

Another type of reproductive form—fairly common in species of *Reticulitermes*—is that of the second form with short wing-pads. This type is developed from the nymph of the second form (Lespès) with short wing-pads, instead of wings or the stubs (scale) of the first form adults. This form is not rare in colonies of species of *Reticulitermes* in the eastern United States.

Unlike the reproductive individuals of the first form, these males and females have not the chitinized parts deeply pigmented; while the compound eyes are reduced in size and palely pigmented they are probably functional. Probably only the first form adults are able to perceive images; the other reproductive castes may be able to perceive light and direction by means of the ocelli and reduced compound eyes. The body pigmentation is slight, but is characteristically straw-colored or grey, suggesting a subterranean habitat and seclusion from light.

In this type of reproductive form the head, thoracic segments, and abdominal tergites and sternites are both longer and broader than in the reproductive forms that develop from nymphs of the first form. The meso- and meta-thoracic tergites have a distinctly irregular shape; in the second form, these chitinized plates of the abdominal tergites and sternites more markedly approach the semicircular in shape and are much more projecting; in mature queens of the first form the tergal and sternal nota of the abdomen are more fused or compressed. However, this latter character may be due to relatively greater age and consequent distention and growth of the fleshy tissue, since in the younger queens of the first form the tergites and sternites are slightly more projecting than in older queens. In first form reproductive adults the legs are more slender and the mouthparts slightly smaller (less gross) than in those of the second form.

In general, recently matured reproductive adults of the second form have a grosser structure; they are heavier and not intended for flight. At the time of maturity (at approximately the same time as the first form adults mature and are ready to swarm), the sex organs of second form adults—unlike those of the first form—are ready to function. Often the abdomen of second form queens has an irregular, lumpy appearance due to the development of ovaries or fatty tissue. Mature queens of the second form of *R. flavipes*, attain a length of 12 mm.; the development of the ovaries is much less than in queens of the first form. The abdomens of second form queens never become as elongate as in case of queens of the first form; they become as much distended, but do not have the oblong or quadrate shape, being more oval, or wider near the end which tapers markedly. Externally, the body tissue of second form queens appears to be coarser and thicker than that of first form queens (possibly due to presence of fat).

"Stylets" or abdominal appendices on the ventral surface of the 9th abdominal segment of the female are absent, disappearing during the final nymphal molt.

The males of the second form reproductive type have the abdomens compressed laterally, which gives the appearance of a narrow, ridged back.

In colonies in eastern United States, the males of the second form are usually found associated with many females of the same form; they are either congregated in one large chamber or suitably distributed in many small chambers. The relative number of the sexes in a colony of *Reticulitermes virginicus* Banks in southern Florida was 32 females to 8 males; these were young reproductive forms. In a colony of *R. flavipes* Kollar, in Virginia, the relative number of the sexes was 28 females to 15 males; the largest female was 10 mm. in length, the average 8.2 mm.

It was formerly believed that adults of the second form, accompanied by groups of workers and soldiers, left the parent colony through subterranean galleries and thus established new colonies. Recent studies by the writer have shown that this is not the only method of colonization, if indeed it occurs at all. This will be discussed in detail later.

There is proof that this type of reproductive form may breed true, *i. e.*, it produces reproductive nymphs only like itself, and not winged adults, or the wingless third forms, (Thompson and Snyder, 1919).

Description of the Adults of the Third Form of Species of Reticulitermes.

A rarer type of reproductive form is that of the apterous third form, sometimes known as "ergatoid" or "worker-like."

The adult of the third form of species of *Reticulitermes* has no wings nor wing-pads, being entirely apterous and worker-like or "ergatoid." There is but little pigment in the chitinized parts; there are only traces of eyes, no doubt due to the wholly subterranean mode of life of this form. The abdomen of the mature queen is oblong quadrate, its shape being more like that of the first form queen. The compound eyes are without pigment. The head, thoracic segments and tergal and sternal nota are not as broad as those of adults of the second form. The segments of the abdomen of mature queens of the third form are less projecting than those of the second form and are less semicircular. The mouthparts and legs are also less gross in structure. Indeed, these queens more nearly approach those of the first form. The development of the egg tubes of third form queens is less than that of either the first or second forms; these queens are of relatively small size—9 mm. being the length of the largest queen of *R. flavipes* so far collected. The antennae of the mature queens consists of 15 segments. "Stylets" or abdominal appendices on the ventral surface of the 9th abdominal segment of the female are absent, disappearing during the final nymphal molt.

Only twenty-four of these forms, all but one of which are females, have been found in colonies of species of *Reticulitermes* in this country. They are apparently rare in species of this genus, but both males and females are fairly common in colonies of *Prorhinotermes simplex* Hagen. The colonies of the species of *Reticulitermes* in which they have been found, have in all cases except two been small. The colony where the young male of *R. tibialis* was found was very large. Three individuals of the species *flavipes* Kol. were found in the same colony, and seventeen in another in Virginia; one of *virginicus* Banks in North Carolina and one in Virginia, (Snyder, 1915); one of *tibialis* Banks in Colorado by A. B. Champlain, and one male of this species found in a large colony collected by B. T. Harvey at Colorado Springs.

Only one mature male of this type has yet been found in colonies of species of *Reticulitermes;* hence nothing is known of the relative proportion of the sexes in the same colony, in case of this reproductive form. However, in colonies of *P. simplex* Hagen, 8 females and 2 males occurred in a colony in southern Florida.

This apterous reproductive form is not able to leave the parent colony except by subterranean tunnels. Like adults of the second form, this type apparently breeds true to type, for no nymphs with long wing-pads, or winged adults, have been found in colonies where mature queens of this form were present.

Occurrence of These Three Reproductive Forms in Other Genera.

The genus *Reticulitermes*, the reproductive forms of whose species I have just discussed, is about midway in the systematic classification between the "lower" and "higher" termites, *i. e.*, the most primitive termites and the termites most highly specialized.

The most primitive Nearctic termites are species of *Termopsis* Heer and *Kalotermes* Hagen. Reproductive adults of the first and third forms have commonly been found in colonies of species of *Termopsis;* those of the second form are apparently not so common in this genus. Only one queen of the third form has as yet been found in colonies of species of *Kalotermes* (*i. e.*, *K. jouteli* Banks of southern Florida). Matured queens of the first form are not rare in species of these genera. In species of *Termopsis* adults of the third form are more common and also apparently more numerous in colonies.

The reproductive forms of the species of the family *Kalotermitidae* Banks, including the genera *Termopsis* Heer, *Kalotermes* Hagen, also *Neotermes* Holmgren and *Cryptotermes* Banks, which are not subterranean in habit, are always to be found in the wood in which the colony is located and are hence often more exposed to the light and their enemies. Species of *Termopsis*, in the northern extension of their range, inhabit logs, stumps, etc., which are covered by snow and ice for long periods in winter.

In the species *Prorhinotermes simplex* Hagen—closely related systematically to species of *Reticulitermes*—whose habitat is the coastal region and the keys of southern Florida, also the West Indies (occurring mainly on islands), third form or apterous reproductive forms are common. This may be an adaptation to the habitat; it is frequently stated that wingless forms are more numerous on islands, the winged forms being blown into the water. Colonies of this species are liable to be caught up by the waters and scattered broadcast. Such apterous forms are adapted to island life by their lack of wings; the isolation helps to perpetuate them and they are dispersed in driftwood.

So far as my own observations go, there are no third form reproductive types in the Nearctic genera of the higher termites, *i. e.*, Holmgren's family the *Metatermitidae*. The "intermediates," as well as the third form adults, have disappeared in the higher, but have persisted in the lower termites. Holmgren and Fritz Müller have each recorded an "ergatoid" queen as occurring in "*Eutermes;*" it may not, however, be a typical third form but the second form with rudimentary wing-pads.

However, the absence of this form may only be apparent, due to insufficient study in the field.

Body Pigment and Eyes.—In species of termites which live in wood above ground but not in earth, certain castes have a more deeply pigmented body than in the case of the subterranean species *Reticulitermes flavipes;* these are the third form reproductive individuals of *Termopsis*, the soldiers and third form reproductive individuals of *Kalotermes*, and the workers, soldiers and third form reproductive individuals of *Prorhinotermes simplex*. The castes of the subterranean species of the genus *Reticulitermes* have pale or dirty white bodies, except the winged adults, which at the time of swarming have a light or dark brown skin, although later, after the underground life has begun, *even this caste may lose some of its pigment.* Species of *Reticulitermes* abandon their galleries in wood above ground during winter and periods of drought and retreat to subterranean tunnels.

The compound eyes and the ocelli are large and well developed in all the castes of *P. simplex*, a species which lives in dead tree trunks or logs, is not subterranean, and hence is more exposed to light in its habitat, so that there seems to be a correlation between the high state of development of the eyes and the habitat of these insects.

In the subterranean species of *Reticulitermes* there are evidences of loss of pigment and the structural elements of the eyes in all castes except the winged insects.

A more thorough and detailed morphological comparison of these three types is to be found in another paper, (Thompson and Snyder, 1920).

"Intermediate" Reproductive Forms.

As previously stated, (Thompson and Snyder, 1919), up to the present time rather few "intermediate" reproductive forms have been described. The reason for this may be either that they have been overlooked thus far, or that they do not exist. The intermediate forms known at present are as follows:

The Rev. F. L. Odenbach, S. J., of Cleveland, Ohio, has reared artificial colonies of termites for over 20 years. He has kept manuscript notes on the forms in the colonies which he has kindly turned over to me. "In one of Odenbach's artificial colonies of *Reticulitermes flavipes*, an enlarged egg-laying queen, figured in manuscript notes and referred to by Snyder (1915, p. 56) has the abdomen distended and the abdominal tergites separated, but possesses long, well-developed wing-pads like a nymph of the first form," (Thompson and Snyder, 1919). The abdomen was distended and the abdominal tergites were separated. This queen laid eggs; she was quite different in shape and color from the normal second form queens. She was slow in her movements and did not change her location in the colony very often; she was tended by the workers.

"Grassi (1893) has figured a queen which, in respect to the length of the wing-pads, is an intermediate between the first and second forms in the species *R. lucifugus* Rossi," (Thompson and Snyder, 1919).

Similar intermediate reproductive forms have been found in colonies of species of *Reticulitermes* in the United States.

In species of *Termopsis* there are a larger series of intermediates between the apterous third form and the normal second form with short wing-pads than in species of *Reticulitermes*. Such forms are also of more common occurrence. The wing-pads vary in length from mere vestigal buds to a length approaching that of the second form.

"In colonies of *Termopsis angusticollis* Hagen, Heath (1903) describes fertile soldiers with wing buds, which produced 'normal progeny.' The question might well be asked—what would be 'normal progeny' under these circumstances?" (Thompson and Snyder, 1919).

"Soldiers with vestiges of wing-pads have been noted by the writers in several species of *Calotermes; C. occidentis* Walker, and two new species from southern Florida; and by N. Banks in *C. minor* Hagen, and other species of *Calotermes*. Vestigal wing-pads are evidently of frequent occurrence in this genus, although these soldiers are in general not fertile," (Thompson and Snyder, 1919).

These intermediate reproductive forms, their fertility, and their progeny will be discussed in more detail later.

Other Insects with Similar Reproductive Forms.

In the aphids there are both winged and apterous reproductive forms. There are also a large series of intermediate reproductive forms—with both short and vestigial wing-pads. Apterous females are a common reproductive type. Unlike termites, parthenogenesis exists among aphids.

Another insect with both winged and apterous reproductive forms is *Zorotypus hubbardi* Caudell, in Silvestri's new order *Zoraptera*—closely related to termites, (Silvestri, 1913). This species of *Zorotypus* produces winged, deeply pigmented adults in the autumn (in Texas). In the parent communities, unpigmented apterous reproductive forms are also present and fairly numerous in communities in Florida and Texas.

In parent communities of another species (*Zorotypus snyderi* Caudell MS) both winged, pigmented adults and a deeply pigmented apterous form occur in Florida.

In case of the deälated adults, apparently no more than a single pair is present in the same *Zorotypus* community in Florida. The winged adults develop from nymphs with wing-pads, which gradually increase in length, as in termites. The winged adult has both compound eyes and ocelli as has the winged adult termite, but has three ocelli, the normal two lateral ocelli (but located differently than in termites) and a median ocellus, instead of the usual two in termites.

As previously stated, two types of apterous reproductive forms occur in species of *Zorotypus*—an unpigmented form and a form which has just as deep pigmentation as the winged adult—which is not usually the case in termites. The compound eyes in this apterous pigmented form are vestigial; the ocelli are as in the winged adult. There are also differences in the antennae of the reproductive forms. See Table I.

Zorotypus lives under conditions closely similar to termites, inhabiting runways under bark on dead standing trees or logs, where it is moist. Often termites are present, and indeed *Zorotypus* at first was believed to be a "termitophile" or "inquiline." Both insects pass the greater portion of their lives in the dark, (Caudell, 1918 and 1920).

Mobility of the Reproductive Forms.

Queens of all three types of reproductive forms of Nearctic termites are more or less active at all periods of their life time, are not imprisoned in a permanent cell and never lose their power of locomotion as do the queens of tropical species which are imprisoned in a permanent, central "royal" cell in a stable colony. The Nearctic queens do not attain the size—they are less than one inch in length—nor is their rate of egg laying as great as that of the queens of tropical species. This must be an advantage, since certain species of *Reticulitermes*, subterranean in habit, are able to go below the frost line in winter and adapt themselves to the most favorable conditions of temperature and moisture when either above ground in wood or in subterranean galleries. Probably in the prairie regions of southwestern United States the reproductive forms are also below ground during long periods of drought when the ground is dry and caked hard; at any rate, they have not been found above ground.

The queens of tropical termites often reach very large dimensions, several inches in length, and become immobile, egg-laying machines. Adequate protection is afforded to these large queens by the huge mounds of great hardness or, in the case of species the queens of which do not attain such large size, but are over one inch in length, by the large spherical tree nests of tough texture.

The queens of Nearctic termites that live in wood only (species in genera of the family *Kalotermitidae* Bks.) are more mobile and their abdomens become relatively less distended than those of subterranean species which are able to retreat to underground galleries.

In young or "incipient" colonies the young first form adults must do all the excavating and forage for themselves. Later, after they have reared broods of workers and soldiers, the former feed them and gradually their rate of egg laying—at first very slow—increases. Eventually the abdomens of mature queens

Table I.

A Comparison of the Different Types of Reproductive Forms of the Isoptera and Zoraptera.

Isoptera Brullé.

Termites (*Reticulitermes flavipes* Kollar):

First Form.	*Second Form.*	*Third Form.*
Winged	Short wing-pads (Brachypterous adult)	Apterous.
Pigmented deeply	Pigmented slightly	Pigmented slightly.
Compound eyes pigmented	Compound eyes pigmented slightly	No compound eyes.
Ocelli—2 lateral	Ocelli—traces	Ocelli—present.
Antennae 17–18 segments	Antennae 16–17 ± segments	Antennae 15–16 segments, (mature queens).

(Type antennae same in all three forms.)
(Thorax different in all three forms.)

Zoraptera Silvestri.

Zorotypus hubbardi Caudell.
Zorotypus snyderi Caudell (MS).

First Form.	*Second Form.*	*Third Form.*	
	(Lacking).	*Z. hubbardi.*	*Z. snyderi.*
Winged		Apterous	Apterous.
Pigmented deeply		No pigment	Pigmented deeply.
Compound eyes pigmented		Compound eyes very degenerate, faint vestiges.	Compound eyes no pigment.
Ocelli 3; 2 lateral 1 median		Ocelli absent	Ocelli 3; 2 lateral. 1 median.
Antennae 9 segments		Antennae 9 segments, 3rd segment short.	Antennae 9 segments, 3rd segment elongate.
Thorax as if in several parts—the case in termites.		Thorax different from first form.	Thorax different from *hubbardi* but close to first form *snyderi*.

become greatly distended and, while these queens are able to move about, they are practically (in case of species of *Reticulitermes*) a charge of the workers. It is not known how long a time is required for queens to reach their maximum post-adult growth—probably a matter of many years in species of *Reticulitermes*.

Queens of species of *Termopsis* and *Kalotermes*, our largest and most primitive living North American termites, have a remarkably small post-adult growth as compared to queens of the smaller and more specialized species of *Reticulitermes*. These more primitive termites are more active; since they do not live in the ground, they can not retreat to subterranean galleries and they are more exposed to the light. These reproductive forms of species of *Termopsis* and *Kalotermes* represent a generalized, primitive, ancestral type, possessing the more independent habits of the non-social insects. In progressing to the higher termites, the queens become more specialized, more dependent and less active.

Habits of the Reproductive Forms.

For several days after the swarm and consequent deälation, pairs of young first form adults of species of *Reticulitermes* in the eastern United States may commonly be found under small pieces of decaying wood lying on the ground—suddenly disappearing into shallow cells excavated in the ground or into similar cells in wood. In these cells copulation takes place and in them the first brood of young is reared. On account of unfavorable moisture conditions, many pairs fail to survive, even after escaping their numerous animal enemies at the time of the swarm.

After several broods have been reared—a process which becomes more rapid and frequent after the first brood is full grown, the colony branches out, extending galleries through the wood and soil underneath. Factors of temperature and moisture greatly affect the colony life and activity is regulated in accordance with these conditions. There is a seasonal variation not only in the predominance of the castes in the colony but also in their position in the galleries. On pleasant days during the warm spring months previous to the swarm, in colonies of species of *Reticulitermes* in the eastern United States, the nymphs of the reproductive forms, the young and eggs are to be found in the outer layers of the colony where they will receive the benefit of the warm sun.

The mature reproductive forms of the wood-boring subterranean species may be found either in the earth or in the wood, depending upon the season of the year and the climate of the locality in which the species lives. During warm weather they are usually above ground in the wood. In winter they are below the frost line in the ground; in the prairie regions, during hot, dry weather when the soil is caked and cracked, they are far below ground.

During warm summer weather, all of these reproductive forms, of species of *Reticulitermes* in eastern United States, are usually within the more solid wood of infested trees, logs and stumps, but, strange to say, they are often in the outer layers of wood.

The burrows in the vicinity of the cell in which large mature queens of species of *Reticulitermes* are present are of larger diameter than usual; these have been used as passageways by the queen in coming up from the ground. A large number of eggs or recently hatched young are usually present in the nest in the vicinity of the reproductive forms.

In the case of the non-woodboring subterranean species, the reproductive forms are usually deep below the surface of the ground, especially during warm, dry weather. Sometimes they are found at a lesser depth in the earth or under stones. In winter they are in the ground below the frost line.

Due to the huge size of normal first form termite queens as compared with the workers and soldiers and the enormous egg-laying capacity of the tropical species, there has always been an unusual interest displayed in these forms. In many tropical termites the large queen is enclosed in a permanent centrally located cell, is unable to move and is a mere egg-laying machine. Certain savage peoples search for these large queens (mere large sacks of eggs) for food; they are considered to be quite a delicacy.

It was formerly believed that, since the queen mother was the source of the colony life, if she were destroyed the colony would be exterminated. This, of course, has been disproved by more recent investigations which have revealed the existence of several other reproductive forms. Young of these other reproductive forms may be among the offspring and continue to populate the colony. Study of the various types of reproductive forms found in the same species of termite and their life cycle has been necessary in order to determine measures of preventing damage by these numerous and widespread insects. Hence any investigations of reproductive forms are of not only biological but also economic importance.

"*Anthropomorphisms.*"

The colony life of the so-called "social insects," *i. e.*, the ants, termites, bees and wasps, has always excited interest. The care of the brood and the queen by the workers and the alarm manifested by the workers and soldiers of termites when the colony is broken into and the brood or queen are disturbed have called forth praise. In these prosaic days of biological facts, much of the mystery of the complex social system of the ants and termites which led to admiration by man has had to "go by the board." Many fantastic theories have collapsed.

One of the first of these theories to go was the instinct for the care of the brood and queen. Nils Holmgren (1909), in his studies of the anatomy of termites, devotes considerable space to the exudate tissues. All of the castes, but especially the queens, have extensive exudate tissues in the abdomen. This exudate passes through pores in the chitin to the surface. Here it is greedily licked up by other members of the colony. Holmgren evolved an "Exudat-theorie" to show that there is a relationship between the amount of exudate tissue and the care that a termite received, *i. e.*, licking and feeding. Instead of the instinct to care for the brood, it is mere selfish desire for the exudation. Holmgren concludes that he regards the exudate secretion not only (1) as the cause of feeding but (2) as the cause of caste differentiation. The work of Miss Thompson (1917) disproves Holmgren's second conclusion and also the whole subject of the "manufacture" of reproductive forms through feeding by the workers, so dear to students of termite biology of the eighteenth and nineteenth centuries.

"Trophallaxis" or Instinctive Behavior.—According to Wheeler (1918), this attribute of the parental feelings of man to insects is termed "anthropomorphism" by the orthodox behaviorists. In a remarkable paper on ant larvae Wheeler suggests the term "trophallaxis," *i. e.*, exchange of nourishment, for the cooperative relationship between adults and larvae. Wheeler further states—

> "Although considerable evidence thus points to trophallaxis as the source of the social habit in wasps, ants and termites, it must be admitted that the phenomenon has not been observed in the social bees."

* * * * *

> "If we confine our attention largely to the ants, I believe it can be shown that trophallaxis, originally developed as a mutual trophic relation between the mother insect and her larval brood, has expanded with the growth of the colony like an ever-widening vortex till it involves, first, all the adults as well as the brood and, therefore, the entire colony; second, a great number of species of alien insects that have managed to get a foothold in the nest as scavengers, praedators or parasites (symphily); third, alien social insects, *i. e.*, other species of ants (social parasitism); fourth, alien insects that live outside the nest and are 'milked' by the ants (trophobiosis), and fifth, certain plants which are visited or sometimes partly inhabited by the ants (phytophily)."

In the termite colony the workers and young nymphs of the reproductive forms may be seen carrying away eggs and young when the colony is disturbed. They solicit exudation from the anus of the queen and also assiduously "clean," *i. e.*, lick, over the bodies of other workers or nymphs, brushing them with the maxillary palpi.

When the colony is broken into, both workers and soldiers evidence alarm when near the reproductive forms, *i. e.*, indulge in convulsive jerky movements of the body—a method of communicating news of the danger to other members of the colony?

At the time of the emergence of the winged colonizing adults, workers and soldiers congregate near the points of emergence with heads toward the exterior.

Reproductive forms of termites are often minus an antenna or leg and nymphs of the reproductive forms sometimes have the wing pads partially bitten off, also the prothorax at the base of the lateral edges—possibly due to eagerness for exudate.

Most of these actions or facts can be explained as due to "trophallaxis." In cases of the bitten wing-pads on the nymphs of the reproductive forms, this may be merely incipient cannibalism; cannibalism exists among termites.

The termite *Anoplotermes fumosus* Hagen, of Mexico and Texas, is usually found in the colonies of other termites or at least closely associated with other termites in the same colony; the other termites are usually species of *Amitermes*. This may be termed "social parasitism" or another form of trophallaxis.

At any rate, these biological facts of behavior are just as interesting, even if due to trophallaxis, as they were when explained psychologically under the fantastical theories of the older writers, which can now be exploded and decried.

The Nymphs of the Three Reproductive Forms.

The three forms of nymphs of the reproductive types of termites have a nomenclature corresponding to that of the mature reproductive forms, *i. e.*, first, second and third. The nymphs of the first and second forms have been known since Lespès in 1856 recognized the second form and described it. Although the adult of the third form has been known since the time of Grassi's classic work in 1893–4—where he termed it a "complementary" form—the nymph has remained unknown until recently when discovered by the present writer in 1917.

The nymphs of these three forms will be described in detail later; briefly, the primary form has elongate wing-pads and develops into the winged, colonizing sexual adult. The nymph of the second form has short wing-pads; it is slightly more elongate than the nymph of the first form; these nymphs are much more active than nymphs of the first form. Nymphs of the third form have neither wings nor wing-pads and but slight traces of eyes.

Description of Nymphs of the First Form of Species of Reticulitermes.

Nymphs of the first form are quite unlike the winged adult, to which they transform; this is not the case in nymphs of the second and third forms.

First form nymphs are white in color, 7 mm. in length (*R. flavipes*), and have elongate wing-pads which extend backward as far as the 5th abdominal segment. These pads are opaque at maturity; they show traces of the adult wing venation. The compound eyes have a reddish brown pigmentation. The antenna consists of 17–18 segments.

The body of this nymph, like most immature insects, has its parts somewhat grosser in structure than the adult.

Stylets or genital appendices are present in both sexes on the ventral surface of the 9th abdominal segment.

Description of Nymphs of the Second Form of Species of Reticulitermes.

Except for the mature pigmentation, second form nymphs in general resemble their adults.

Second form nymphs are white in color and 7–7.5 mm. in length (*R. flavipes*). Instead of the long wing-pads of the nymphs of the first form, nymphs of this form have but short wing-pads or vestiges extending only to the 3rd abdominal segment. The antenna has 17–18 segments (*R. flavipes*). When matured to adults they attain slight pigmentation to the chitinized portions of the body; they possess only partial pigment in the compound eyes. Adult maturity is attained normally after the nymphs of the primary form have developed to winged, pigmented adults. Even as immature nymphs, second form nymphs are more active than those of the first form, yet their body structure is grosser in all parts.

As adults of the second form, they are sexually mature, whereas first form adults do not attain their maturity until after the swarm.

Stylets or abdominal appendices are present in both sexes on the ventral surface of the 9th abdominal segment.

Description of Nymphs of the Third Form of Species of Reticulitermes.

For many years the writer had noted that in certain colonies of species of *Reticulitermes*, where there were numerous eggs and recently hatched young, it was impossible to find any enlarged first, second or even third reproductive forms. Nevertheless, in these colonies, nymphs worker-like in form, but with creamy white abdomen, often occurred. It was then suspected that these might be young reproductive forms of the third type.

Careful histological study has proved this to be the case, (Thompson and Snyder, 1920).

In general, third form nymphs resemble the adults except they lack the mature pigmentation.

Third form nymphs are creamy white in color, 5–6 mm. in length (*R. flavipes*); these nymphs are entirely apterous and possess neither wings nor wing-pads and but slight traces of the compound eyes; the antenna has 16–17 segments (*R. flavipes*). Hence they are worker-like or "ergatoid." When mature, they attain a partial—very slight—pigmentation.

Stylets or abdominal appendices are present in both sexes on the ventral surface of the 9th abdominal segment.

Description of Nymphs of the Reproductive Forms of Other Genera of Termites.

In species of *Termopsis* nymphs of both the first and second forms have relatively shorter wing-pads than in species of *Reticulitermes*. There are numerous forms with rudimentary wing-pads —intergrading intermediates between the nymphs of the second and third forms. These intermediate nymphs and nymphs of the third form are common. Nymphs of the second form are apparently not common in colonies; this is also true of second form adults.

Prorhinotermes simplex Hagen, an Antillean termite, which occurs in southern Florida, has second form nymphs with peculiar curved and fused wing-pads (expanded thoracic plates). These nymphs and nymphs of the third form are common. Nymphs of the first form of this termite have not been found in Florida, but occur in Jamaica.

Development of the Nymphs of the Reproductive Forms.

In eastern United States nymphs of the first, second and third reproductive forms of species of *Reticulitermes* may attain their full mature length in the autumn. During late October and November, 1918, first form nymphs were found in colonies at Falls Church, Va., on which the wing-pads were of full length and with a light-pinkish pigmentation in the eyes, as Dobson (1918) has found to be the case in the vicinity of Boston, Mass. However, full maturity of the nymphs of the first form, with the attainment of opaqueness of the wing-pads and fuller pigment to the eyes, is not until spring (the last of March or first of April) in Virginia. The nymphs of the second form become mature shortly afterwards—before the swarm. It is not known definitely when the third form nymphs become mature. Nymphs apparently mature have been collected in the late summer and fall in

Virginia and Massachusetts.[1] Nymphs of the first, second and third forms at the proper season of the year pass through quiescent stages of comparatively short duration, during the final molt, to their adult type.

Prior to this final molt a series of molts have occurred, the number varying with the caste; in case of Nearctic termites, however, the definite number of molts necessary from hatching to maturity is unknown. Nevertheless, it is known that nymphs of the adults of the first form require a greater number of molts before attaining maturity than do the workers or soldiers.

In the case of the nymphs of the first and second reproductive forms of species of *Reticulitermes*, there is an elongation of wing-pads during development; in all castes the segments of the antennae increase in number. During the final molt of all three reproductive forms—which occurs normally in the spring or summer in the case of eastern species, the anal appendices are lost in the female sex. Shortly after the molt, mature pigmentation is attained. This quiescent stage apparently serves the same purpose as the pupal stage of insects with a complete metamorphosis or development, since the most marked changes, both external and internal, take place during this molt.

The whole period intervening between the fully developed nymph of the first form and the maturely pigmented winged adult is about one day and one-half to two days for individuals, and about one week to ten days for the colonies, in case of species of *Reticulitermes* in southeastern United States.

A more detailed illustrated description of the quiescent stage and final molt of nymphs of the first and second forms has already been given in a previous paper, (Snyder, 1915). The manner in which the skin is shed, the attaining of pigmentation, the influence of moisture, and peculiar abnormalities are all discussed.

Comparison of the Development of Termite Nymphs with that of Nymphs of Aphids and Zorotypus.

It is rather interesting to note that in the nymphal development of aphids, unlike termites, the "intermediate" female reproductive form, with short wing-pads, originates from a nymphal form with long wing-pads, (Turner and Baker, 1915). From the normal nymph ("pupa") with the usual type of wing pads there develop a large series of different "intermediate" reproductive forms; in some cases there being a loss of eyes and wing-pads or the length of the wing-pads is reduced—a reversion.

In the case of *Zorotypus hubbardi* Caudell, as in termites, the unpigmented apterous reproductive adult develops from an apterous nymph, while the pigmented winged adult develops from a nymph with long wing-pads. It is not known what nymph is the prototype of the pigmented apterous reproductive adult of *Zorotypus snyderi* Caudell.

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[1] Mature young third form reproductive adults were found in a colony of *R. flavipes* at Chain Bridge, Va., May 6, 1920, (before the swarm) along with mature young second form reproductive adults and mature winged sexual adults.

The Methods of Colonization (Formation of New Colonies).

Flight of the Winged Colonizing Forms of Termites.

The terms "swarm" and "nuptial flight" are neither appropriate in referring to the emergence of the winged sexual adult termites, which is merely a colonizing flight and an aid in the dispersal of the species. In case of species of *Reticulitermes*, after a short, irregular, unsteady flight, the males and females alight on the ground and separate into pairs. There is a marked sexual attraction and the males follow the females about. The females find a suitable site for the new colony and the pair becomes established. Sexual mating or copulation does not take place at the time of the swarm, which is, therefore, not a "nuptial flight." Neither does copulation take place immediately after the swarm, but only after the pair are established in the new colony and the sexual organs have matured. Usually males and females from the same colony mate, but sometimes they mate with individuals from nearby colonies which are swarming at the same time.

These insects that have taken this flight never return again to the parent colony, or again congregate in the same colony as does the honey bee, but form new colonies.

Usually the colonizing adults of the same species make their first flight, which is numerically largest, at the same time in a wide area of country. This annual production of winged sexual adults in enormous numbers is undoubtedly for the further diffusion and perpetuation of the species; a wider diffusion can be accomplished by flight than through subterranean tunnels. Furthermore, places otherwise inaccessible can be reached; for example, some termites have colonies in the buttresses of the few remaining large bald cypress trees (*Taxodium distichum*) in Lake Drummond, Dismal Swamp, near Wallacetown, Va.

Unless carried by the wind, termites do not fly very far. The great majority of the colonizing adults of species in the genus *Reticulitermes* and other subterranean species, after the short vacillating flight, alight or fall to the ground and lose their wings. They then excavate cells in or under decaying wood lying on the ground.

The night-flying species of the family *Kalotermitidae* are stronger fliers; they retain their wings until they have located a suitable place to excavate a cell in wood.

Diurnal Swarming.—The species of *Reticulitermes* in the eastern United States always swarm during the day time; in the vicinity of Washington, D. C., usually in the morning or about noon of a warm, sunny day in the spring or summer. Sometimes there are large numbers of winged adults present in colonies of species of *Reticulitermes* in the eastern United States, and it is probable that there are also swarms in autumn.

Only one species of this genus (*R. aureus* Snyder) has ever been collected at night (at light in Arizona), so they are probably not normally nocturnal in habit. Rainfall is not a factor that induces swarming in the more humid east.

Amitermes tubiformans Buckley and *A.* (?) *perplexus* Banks swarm during the day in Texas.

Small inconspicuous species swarm during the daytime.

Nocturnal Swarming.—Species of the genera *Termopsis*, *Kalotermes*, *Constrictotermes* Holmgren, and *Nasutitermes* Banks are night-flying termites, and their winged adults have been collected in large numbers on the wing at lights at night; this is probably an aid to mating, by bringing the sexes together. They are strong fliers. In the case of *Termopsis angusticollis* Hagen and *T. nevadensis* Hagen, the swarm usually begins at dusk but the insects continue to fly until late in the evening. The same is true of the species of *Kalotermes*.

The period of flight of species of *Termopsis* in the same locality extends over a period of several months in summer and autumn, *i. e.*, often from early to late summer. In this case the flight does not consist of large numbers of adults, but of 50 to 200 adults, more or less.

Large conspicuous species swarm after dusk.

In arid or dry sections of the country, as in certain portions of the southwestern States, on the prairies and Great Plains, termites usually swarm after a rainfall or during a light drizzle, as is characteristic of many tropical termites. This is an adaptive habit probably due to the fact that the ground is dry and hard and, unless the swarm occurred just after or during a rain, the termites could not establish or would have great difficulty in establishing new colonies. These conditions of soil do not prevail in the more humid eastern portions of the United States, where the ground is usually more moist and favorable; in consequence rainfall has no influence on the time of swarming.

Seasonal Variations in the Time of Swarming.

The different species of the same genus rarely swarm at the same time in the same locality; this effectively prevents interspecific breeding.

The dates of swarming, or the colonizing flights of termites vary not only with the species and the geographical location, but also with the season.

There may be several swarms of adults of a species of *Reticulitermes* from one colony, distributed over a period of several weeks. The first swarm, however, consists of the greatest number of individuals.

Species in the family *Kalotermitidae* may fly irregularly over a period of several months.

New or incipient colonies are established, after a short flight, by the winged colonizing sexual adults of the first form, that swarm. These colonies are formed in the earth under decaying wood lying on the ground; in this wood; under loose bark on dead trees or logs; or in crevices in trees—anywhere where there is a sufficient supply of moisture. Within a few days after the swarm the young parent adults may be found in such sites, but they later disappear, penetrating more deeply into the wood.

These winged males and females of the first form, after losing the wings, become the reproductive forms of the normal or first form type with wing stubs. Reproductive forms of this type are not rare or difficult to find at the proper season of the year in colonies of species of *Reticulitermes* eastern United States, but in the region of the Great Plains they must be far below ground during dry seasons, since they have not been found as yet. Conditions in these regions may be somewhat similar to those in Sicily where Grassi (1893) studied the habits of *R. lucifugus* Rossi, and account for the fact that he was unable to find this type of reproductive form. Grassi believed that the colonizing forms were all destroyed or irretrievably lost at the time of the swarm.

The "Pseudo-Flight of the Second Form Colonizing Adults of Reticulitermes Virginicus Banks.

As has been previously stated: "The colonies of *Reticulitermes flavipes* Kollar and *virginicus* Banks, found in the southeastern United States in the spring, often contain nymphs of the second form, sometimes in large numbers, associated with either nymphs of the first form or winged sexual adults. These young reproductive types of the second form attain their mature pigmentation at about the same time that the colonizing winged adults or reproductive types of the first form swarm, but after the swarm they are not found in the parent colonies. We may ask why they are produced and what becomes of them? They are not needed in the parent colony any more than the winged colonizing forms, and it may be that they are impelled to leave the old colony by the same irresistible force that induces the swarm or flight." * * * "Since the origin of the castes is due to intrinsic causes, (Thompson, 1917), a certain proportionate number of these nymphs of the second form may be produced each year in long established colonies with parent first form adults, they would evidently be superfluous if the original reproductive forms of the parent colony were present, and might, therefore, be forced to migrate," (Thompson and Snyder, 1919).

The manner of formation of new colonies by adults of the second form is not even yet definitely known. It was formerly believed that, at about the time of the swarm of the colonizing adults of the first form, the wingless adults, accompanied by workers and soldiers, left the parent colony through subterranean galleries. This method of colony formation would be fairly sure and rapid, avoiding most of the dangers to which the winged adults are exposed when they come above ground and fly in the sunlight. This would be another safeguard to insure the dispersal and perpetuation of the species. Under these circumstances, the reproductive forms would not have to establish a home for themselves nor forage for food—as do the adults of the first form, they would be cared for and nourished by the workers, their only function would be reproduction. The number of eggs laid and the rate of increase would be rapid in colonies founded by second form adults on account of the care and also the fact that these forms are polygamous and that a large number of females and a proportionate number of males are present. The rate of increase in such colonies would greatly surpass, from the first, that of the single pair of first form adults.[1]

In view of these previous surmises as to methods of subterranean colonization, an observation made of a swarm of *Reticulitermes virginicus* Banks at Falls Church, Va., on June 7, 1919 is of interest and value. The winged adults were observed at 10.45 A. M. (sun time) flying from a stump at an oblique angle in a narrow mass; they flew towards the southwest. The winged forms were clustered in large numbers on top of the stump (in woodland) in which the colony was located, the white wings and black bodies giving the mass a grey appearance. The day was hot and bright and the insects were strikingly visible as they flew in the sunshine. The beginning of the swarm was not observed, but the flight was over at 11.15. (There was a thunder storm and rain about 4 P. M.) As is usual, chinquapin (*Castanea pumila*) was in first full bloom, coincident with the swarm of *R. virginicus*.

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[1] Feytaud states that the first form adults are useful to the entire race, whereas adults of the second form are merely useful to the individual colony. It will be shown later, however, that second form adults may mate with members of other colonies and thus escape in-breeding.

Silvestri believed that the substitution of the "complementary" sexual forms for the deälated was due to calculation on the part of the workers, due to the greater reproductive powers of the larger number of "complementary" queens than that of a single deälated "true" queen. In that event the latter was sacrificed.

Feytaud also explains the more general occurrence of the "substitute" queens in case of the species *R. lucifugus* as due to climatic influence, maintaining that the winged forms were very sensitive to varying conditions of humidity.

When the winged adults had nearly all left the top of the stump and I had finished taking photographs of the swarm, a careful examination of the top of the stump was made in search of the abnormally developed winged adults or deformities which usually accompany a swarm, (Snyder, 1915). With these abnormalities and a few belated remaining normal winged adults were found quite a few pigmented adults of the second form actively running about the top of the stump in the nearly full sunlight. They came out of crevices and ran about and sought other crevices, fell off the stump to the ground or into a spider web at one side of the stump near the base. This was possibly a manifestation of or a reversion to the ancestral habit of swarming—these apterous forms have inherited the instinct to swarm but not the wings and this running about is all that they can achieve. Apparently, these adults were able to "keep their course," either by vision, by tactile sense or olfactory sense perception.

Second form adults of both sexes were present; the body pigmentation in some cases was darker than usual (although just as dark forms have been found previously) and the compound eye was more pigmented and prominent than is normally the case.

Several theories may be propounded to account for the presence of the second form adults outside of the parent colonies or the "pseudo-flight:"

1. These may be in reality abnormally developed first form adults. The shortness of the wing-pads and pigment would render this doubtful since first form adults do not attain pigment till the wings are fully expanded. However, there are other characters, both external and internal, which have definitely disproved this conjecture. The chief external character by which it can be proved that these are second, and not first form, adults are the meso- and meta-thoracic tergites. In the first form they are in two main parts, whereas in the second form they seem to

be only in one part. The size of the body and the size of the eyes and ocelli are other external characters which determine that these are second form adults.

Stained total mounts show definitely that, according to form and size of the brain, frontal gland, sex organs, and other internal organs, these are young second form adults.

Therefore, if they are normal second form adults, this theory is disproved.

However, granting that:—2. They are normal second form reproductive adults, they might have been accidentally carried out of the parent colony by the emergence of the winged forms—the normal (?) method of egress of second forms being by subterranean galleries. Only additional observations in the field can definitely determine whether this is the case or not, but it is very improbable!

Another view might be that:—3. This "pseudo-flight" is the normal method for the egress of second form adults from the parent colony—they being later "adopted" by small bands of foraging workers and soldiers. This may be possible, but is a rather haphazard "hit or miss" method.

It is much more probable that:—4. This "pseudo-flight" is the normal manner of the exodus and the young second form adults are able to survive alone. This is the natural and an entirely reasonable supposition, but there are biological facts that tend to disprove this, or at least throw some doubt on this view. As will be shown below, this reproductive caste is apparently greatly dependent upon workers.

It may be that:—5. The normal egress is through subterranean galleries, the reproductive forms being accompanied by workers and soldiers.

Or that:—6. The second form adults, emerging from the parent colony through subterranean galleries, are "adopted" by foraging workers.

The most probable of these views, based upon rather incomplete field data, are:—

That the "pseudo-flight" is the normal manner by which second form adults establish new colonies and that they are able when young to survive without the aid of workers and soldiers. It is possible that second form adults may also leave the parent colony through subterranean galleries, being accompanied by workers and soldiers.

Subcolonies or temporary colonies are frequently found with apparently only workers and soldiers present; these subcolonies, which furnish increased facilities for habitation and food supplies, are possibly offshoots from the parent colony or nest and are established by means of subterranean passages, which are extended for long distances by the foraging workers and soldiers.

Sometimes, however, similar small colonies are found with young second or third reproductive forms present.

From the foregoing will be seen that it would be possible during this "pseudo-flight" for adults of the second form from one colony to mate with those of another colony—a rather remote possibility in case the exodus were through subterranean galleries—and exclusive in-breeding avoided, just as in case of the winged colonizing adults.

In view of the fact that the sex organs of the young second form adults are ready to function at the time of the pseudo-flight—which is not true of the young first form adults at the time of the flight—copulation undoubtedly occurs as soon as the sexes are established under decaying wood on the ground, under bark, or in some other suitable location. It is probable that many adults congregate together in a suitable habitat. It is extremely doubtful if there ever is monogamous pairing in this caste, as is the rule in the case of the first form adults.

Indeed, even mating and subsequent cross-breeding between first and second form adults might be brought about by means of the pseudo-flight. But on account of the rarity of the occurrence of such cross-breeding between two different types of reproductive forms in colonies in nature, such an event probably does not often occur.

These peculiar relations are also, however, usually under conditions of polygamy due to congregation of the sexes. It would be rather difficult for even a zealous and adventurous first form male to collect a "harem" of 16 second form females, such a ratio of sexes and castes being found in colonies in the field. But a first form male could enter the habitat of second form reproductive types and breed with the females (or the sex relation be reversed), after the sex organs of the first form adults had matured.

Subterranean Exodus of Third Form Colonizing Adult Termites.

Young adults of the third form are present in colonies of species of *Reticulitermes* in the southeastern United States, at the proper season of the year. Like adults of the second form, these third form adults become sexually mature before the winged adults of the first form..

The lack of pigmentation to the body and absence of the compound eyes very probably indicate a subterranean mode of exodus from the parent colony—accompanied, without doubt, by workers and soldiers. If it were necessary for these forms to be exposed to the light there would be pigment in the body tissue.

In case of species *Termopsis*, which are not subterranean in habit, third form adults, which are found in colonies, have deeper pigment to the body and portions of compound eyes are present. Offshoot colonies may be established in the same log or even in nearby logs by these third form adults.

Third form adults of *Prorhinotermes simplex* Hagen have a deep pigmentation to the body and have both eyes and ocelli; hence these reproductive forms are capable of coming out of parent colonies in infested logs into the full sunlight and establish new colonies in nearby logs. The deeply pigmented apterous adults of species of *Zorotypus* may do likewise; it is not yet proved whether *Zorotypus* is a social insect with a caste system, or not, *i. e.*, lives in colonies or is merely gregarious and lives in communities. If the latter is true, of course the migration would necessarily not be accompanied by workers. Much of this, however, is conjecture.

Third form adults of termites, like adults of the second form, are polygamous, there being a large number of females to a small number of males. The presence of either of the two types of third form reproductive adults of *Zorotypus* in large numbers in the same community indicates that the habit of polygamy likewise occurs in case of apterous adults in the order *Zoraptera*.

Results of Breeding Experiments.

The preliminary results of breeding experiments conducted with species of *Reticulitermes*, *Neotermes* and *Termopsis* have already been briefly outlined in previous papers, (Snyder, 1915, Thompson and Snyder, 1919, and Banks and Snyder, 1920). A more detailed account will be given herewith. Heath (1903) has described breeding experiments conducted with species of *Reticulitermes* and *Termopsis;* some of Heath's results need further elucidation.

Feytaud (1912) has published the results of his breeding experiments with *Reticulitermes lucifugus* Rossi; Feytaud's results differing somewhat from those obtained by the writer with other species of *Reticulitermes* in the United States; unlike in the writer's experiments, no soldiers were reared in his incipent colonies.

Wheeler (1907) states that: "In incipient ant colonies, the queen mother takes no food, often for as long a period as eight or nine months, and during all this time is compelled to feed her first brood of larvae exclusively on the excretions of her salivary glands. This diet, which is purely qualitative, though very limited in quantity, produces only workers, and these of an extremely small size (micrergates)."

It will be seen that, while the life history of ants and termites is quite different, in both insects the establishment of incipient colonies is no easy matter, and that the results of this struggle for existence are reflected in the character (both as to caste and stature) of the progeny.

A discussion follows of the progeny of the different types of termite reproductive forms.

Progeny of First Form Adults.

In case of termites, in incipient colonies of species of *Reticulitermes* and *Termopsis* the young couple of deälated adults share the small, shallow cell, at which time the abdomens of both the male and female become slightly distended. This is due both to development of sex organs and body fat. Unlike the young deälated queen ant in an incipient colony, both young parent adults masticate wood for food. The first brood of young develop to workers and a few soldiers, these individuals of both castes being slightly smaller than normal adult individuals in old, long-established colonies. No nymphs of sexual adults are produced during the first year; the reason for this will be explained later.

This smaller size of workers and soldiers of the first brood may be explained by the fact that, while in the older colonies the young would receive food from and be cared for by a large number of workers, in incipient colonies, the young would receive only the care of the young parent adults.

The rate of egg laying of the young and active queens of species of *Reticulitermes* is not very rapid; clusters of eggs in numbers varying from 6 to 12 are in the cells with the young pairs. Hence, the new colony is at first very small; even after rearing the first brood of workers and soldiers the increase in numbers is not rapid.

About the middle of July, 1912, at Falls Church, Va., about 12 small white eggs in a cluster were observed in a cell with a young pair of *Reticulitermes flavipes* Kollar. At least three reproductive forms were observed, probably two males and one female. These had been captured after the swarm on May 8, in the earth under a small piece of decaying wood. On July 29, the first newly hatched young were observed, and on October 30, seven workers and one soldier surrounded a single deälated pair of reproductive forms. Fragments of the chitinized parts of another deälated reproductive adult were found in the wood near the cell containing the young colony. The abdomen of this egg-laying female, 13 months after swarming, was oblong and somewhat distended, the segments of the abdomen being slightly separated and displaying the white pleural tissue between. No eggs had been laid since those deposited in July; during this time the male continued to cohabit with the female and both adults were active.

Thus it will be seen that development under the foregoing conditions is at best a slow process. The male and the female are equally important in the establishment of the new colony and in the independent rearing of the first brood of young. This brood is reared within the confines of this small chamber.

On February 21, 1913, nine or more additional eggs were observed in a cluster near the cell of the above mentioned pair. On February 24, the first recently hatched young were observed. The abdomen of the queen at this time was not markedly distended. On May 16, freshly hatched young were again present in this colony. On August 15, six eggs, as well as recently hatched young, were present in the cell. The male still cohabited with the female, and the abdomen of this young queen was not as yet markedly distended.

While recently hatched young are active, they are dependent on the care of the young parents, or later, upon the workers for prepared food.

Termites differ from other social insects, such as the ants and the honey bee, in that the sexual relations of the male and the female are continuous. Copulation probably does not take place until about one week after the swarm and the establishment of the pair in a cell in wood, but is repeated at irregular intervals over a period of many years. Copulation and egg laying ceases in the young colony after the first batch is laid and is not resumed until this brood is mature. Thereafter copulation and egg laying occur at shorter intervals and more frequently until with the growth of the colony the abdomen of the queen gradually enlarges, eventually becoming greatly distended, due to the enormous development of the ovaries through the constant care and feeding of the workers; she no longer masticates wood for food (the jaw muscles degenerate—Thompson and Snyder, 1920), but is fed on prepared food by the workers. Such an actual post-adult growth is rare among insects.

However, queens of Nearctic species of termites never attain the size of tropical species. Even in large, well-established colonies the rate of egg laying of single deälated queens is not remarkable. However, in large long-established colonies tens of thousands of eggs are present; unfortunately, the type of reproductive forms present in such colonies is not known.

Similar rearing experiments were carried on with other species of *Reticulitermes* with practically the same results. The following is a tabulated statement of the rearing of a brood by a pair of deälated adults of *R. virginicus* Banks.

On May 18, 1915, at Falls Church, Va.

Mature nymphs of the first form and those in quiescent stages, also sexual adults attaining wings and mature pigmentation, were placed in rearing.

June 5, 1915. Sexual adults swarmed.

June 25, 1915. First eggs in royal cells in wood.

Middle July, 1915. Egg laying completed.

August 4, 1915. Eggs not yet all hatched, nymphs in various stages of development. Abdomens of queens not markedly distended, males in cells with females.

December 3, 1915, Workers and soldiers attaining maturity.

January 8, 1916. Same.

February 9, 1916. Workers and soldiers nearly mature, workers 3 mm. in length. Soldiers 4 mm. in length. Eggs in clusters in galleries over 1 dozen. Eggs approximately .70 mm. in length and nearly .5 mm. in width, vary in size. Many workers with mutiliated antennae. Reproductive, forms active antennae mutilated and abdomens of queens not markedly distended or the segments as yet separated.

February 17, 1916. Eggs as yet unhatched since February 9/16. No recently hatched nymphs, only about $^1/_2$ dozen eggs observed.

March 2, 1916. 2 recently hatched nymphs and 6 unhatched eggs in nest, eggs in cluster and active young nymphs near eggs.

March 15, 1916. 2 unhatched eggs and 2 recently hatched young observed in nest, nymphs near eggs.

April 5, 1916. Eggs all hatched, nymphs in various stages from recently hatched to twice this size, 3.5 mm. workers, 4.5 mm. soldiers; workers and soldiers 13 segments to antennae, mature.

June 6, 1916. Worker 3.5 mm. in length, mature, some soldiers only 3.5 mm. in length.

It has been shown that, in incipient colonies of *Reticulitermes* in southeastern United States, most of the young of the first broods develop to workers with a few soldiers and that no nymphs of the sexual individuals are developed during the first year. The workers constitute the caste most necessary for the welfare and conduct of the new colony.

Feytaud (1912) obtained no soldiers in the initial broods of colonies of *Reticulitermes lucifugus* Rossi in Europe; he did find nymphs of sexual adults in colonies during the first year (after 8 months)—which leads him to the conclusion that this was a sign that the stability of the colony was assured.

When old, first form queens with distended abdomens are taken from well stocked long-established colonies and are placed in artificial colonies—with or without the male—and with workers and soldiers, their abdomens soon become shrunken and the female dies. This is possibly due to insufficient nourishment. Very often the male survives.

Younger first form queens from small colonies, although the abdomen becomes shrunken, continue to live—with or without the male—since the number of workers necessary for their support is not so great.

In the absence of the male the eggs which are laid by mature queens are infertile; they do not hatch.

In case of species of *Termopsis*—large primitive termites—the initial rate of egg laying and development is somewhat more rapid. As many as 15 to 30 eggs are laid by young deälated parent adults, (Heath, 1903).

Nearctic species of *Kalotermes*, which although some morphological characters make it appear to be more primitive than *Termopsis*—such as the presence of ocelli—are less primitive, as is evidenced in the numerous, more sharply defined species of *Kalotermes* and in the reduction of certain parts. The initial rate of egg laying of species of *Kalotermes* is about the same as that of species of *Reticulitermes*—namely 6–12 eggs in the first batch.

Progeny of Second Form Adults.

In certain colonies of termites, reproductive individuals of the second form occur with a small proportion of males to a large proportion of females. In the genus *Reticulitermes* as many as eight males together with thirty-two females, and fifteen males with twenty-eight females, both sexes of the second form, have been found.

In species of *Reticulitermes*, 40 to 100 reproductive individuals of the second form may be present in the same colony, suitably distributed by small groups in separate chambers in different locations in the colony.

Apparently these reproductive forms are more numerous in small sized colonies than in older, long-established colonies. Doubtless there is a high rate of mortality among young reproductive forms of this type. While the ovary development of mature individual queens of the second form is not as great as in queens of the first form, the habit of polygamy makes the rate of egg laying in the colony greater in case of second form queens.

Both field observations and breeding experiments seem to indicate that the second and possibly the third forms produce, in addition to the sterile workers and soldiers, only their own fertile types and never nymphs of the first form. In other words, the second and third form reproductive adults apparently breed true to their fertile types. In some artificial colonies with parent reproductive individuals of the second form, no reproductive forms but only sterile workers and soldiers have been produced. This seems to be the case in the two following experiments, (Thompson and Snyder, 1919).

The Rev. F. L. Odenbach received in September, 1900, a small colony of termites (*Neotermes castaneus* Burm.) from Florida. He placed these insects in an artificial nest and has continued to make observations on their habits. On July 1, 1902, eggs were found in the nest. In February, 1908, about 150 members were present in the colony. In September, 1908, and again in June, 1909, reproductive forms were observed in the nest, much larger than the other members of the colony, and some with an enlarged abdomen, the body segments appearing as prominent chitinous bands, due to distention, a characteristic of the older termite queens. From Odenbach's description these were evidently reproductive individuals of the second or third form; this will be determined later, since at present it is not desirable to disturb the activity of the colony. In December, 1910, approximately 200 individuals were in the nest. This colony was still alive in September, 1917. Nymphs and soldiers, but no forms with wing-pads nor any winged adults have been produced in this colony after 17 years of breeding.

On August 2, 1915, the writer received a colony of a termite (*Reticulitermes tibialis* Banks) from Ivywild, Colo., found in a scrub white oak, and consisting of workers, soldiers and nymphs. On November 22, 1915, 3 females with abdomens considerably distended and 2 males with slightly distended abdomens were observed in the nest. These were reproductive individuals of the second form and had greyish and yellow pigmentation in the chitinized parts. While numerous eggs have been found every month in the year in this artificial colony, maintained indoors, and while the number of workers and soldiers has increased, no forms with wing pads or wings have been produced up to December, 1918, after 3 years of breeding, and the colony is large—several hundred members—and healthy.

On December 31, 1918, the wood in which this colony was located was opened and a careful inventory was taken of the colony. Four reproductive forms and young were observed. Since then the colony has failed and a large number of workers died, probably due to this disturbance.

On June 27, 1919, second form reproductive adults were still living in the wood; very few workers were observed. The abdomens of the reproductive forms had shrunken.

On September 25, 1919, only 2 second form adults were found to be alive; the abdomens were shrunken but the pigmentation of one form appeared to be darker—the latter possibly due to unfavorable moisture conditions. Very few workers and no soldiers were observed; the colony appeared to be moribund.

A more careful examination on October 4, 1919, revealed that the darkly pigmented form was a male of the normal second form with short wing pads, whereas the lighter colored form was a female with very short or vestigial wing pads—an intermediate. The abdomen of this queen was not distended. Only 6 living workers were found. The colony was still alive and was watched with considerable interest to observe developments. It was not believed that these old forms could thrive or reproduce without a large number of workers to care for and feed them.

On December 15, 1919, all the termites in this colony were dead.

The criticism can scarcely be made that there has not been sufficient time for the production of winged forms, for even in recently established incipient colonies in nature the nymphs of the winged reproductive forms are produced after 18 months.

Heath (1903) found winged adult termites of *Termopsis angusticollis* Hagen swarming from nests in which males and females of the first form were present, the nests being only two years old and containing 200 individuals.

The writer has made observations on the habits of termites since 1912, mainly in the southeastern United States, but in the season of 1917, during an extensive field trip through Florida, the southwest, the Rocky Mountain and the Pacific Coast regions. It may be stated with certainty that: (1) In long-established colonies, in which large fertilized queens of the second form occurred, no nymphs or winged adults of the first form have been found; (2) in all colonies in which queens of the third form were found, no nymphs or winged adults of the first form occurred; most of these colonies, however, were small or young, that is, they had been recently established.

In one large colony of *R. flavipes* in Virginia, with 17 third form queens present, a few nymphs of the second form were found.

In species of *Reticulitermes*, mature second form queens, like those of the first form, will not survive in artificial colonies unless there are a large number of workers present to care for them.

No mature second form adults have as yet been found in colonies of *Prorhinotermes simplex*.

Insufficient specimens of reproductive individuals of the second form have been thus far found in colonies of *Termopsis* and *Kalotermes* to warrant the drawing of definite conclusions.

In the higher termites—the *Termitinae* Banks—such as *Ami-*

termes tubiformans Buckley, as yet only a few form second adults have been found and these have been young, (Banks and Snyder, 1920).

Progeny of Third Form Adults.

For many years the writer has found that in certain colonies of species of *Reticulitermes*, where there were numerous eggs and recently hatched young present, it was often impossible to find mature or enlarged reproductive forms present. Nevertheless, in these colonies often nymphs, or young adults, worker-like in form but with creamy white abdomens occurred. It was suspected that these might be reproductive forms and such has proven to be the case, (Thompson and Snyder, 1920).

The ovary development of individual queens of the third form is less than that of either that of the first or second forms, (Thompson and Snyder, 1919). However, reproductive adults of the third form, as well as those of the second form, have the advantage over those of the first form of being polygamous.

It is not known what the relative proportion of males is to females in reproductive individuals of the third form, due to the difficulty in distinguishing these males from the workers.

In a large, long-established colony of *Reticulitermes flavipes* at Falls Church, Va., 17 mature queens of the third form with markedly distended abdomens were transferred to an artificial colony. The abdomens became shrunken, although a fairly large number of workers and soldiers were present, and they soon died—without doubt due to lack of sufficient nourishment.

In case of species of the more primitive genera *Termopsis* and *Kalotermes*, reproductive individuals of the third form are active and their abdomens are relatively not so markedly distended as in species of *Reticulitermes*. They are not so dependent upon the immature nymphs of the reproductive forms for care and nourishment as these queens are upon workers in species of *Reticulitermes;* the nymphs take the place of the workers, which are lacking.

There are no data at hand, as yet, as to the habits of the mature third form queens of *Prorhinotermes simplex*. The proportion of the mature males to the females in a representative large colony in southern Florida was 2 males to 8 females. In a smaller colony of this termite, 11 young third form adults were found, 4 being males and 7 females.

There is need of more data on reproductive adults of the third form. Like adults of the second form, they apparently breed true to type and never produce first or second form adults.

Progeny of "Intermediate" Reproductive Forms of Termites.

There is, as yet, no reliable data on the progeny of any of the intermediate reproductive forms. However, it is believed, from facts noted during observations of colonies in the field and from the results of breeding in artificial colonies, that the intermediate forms with mere wing vestiges probably breed true to type, as do second form adults.

It would be extremely interesting to know whether or not the intermediate reproductive form with long wing-pads—resembling a nymph of the first form except for the mature pigment, which is as in second form adults—produced winged adults or not.

Infertility of Termite Soldiers with Wing Vestiges.

In colonies of species of *Kalotermes* soldiers with rudimentary wing-pads and deeper pigmentation are fairly common—a possible reversion to the winged ancestral condition.

In this connection, it is also interesting to note that recently a colony of the large primitive termite *Kalotermes occidentis* Walker has been found in Sabino Canyon in the Santa Catalina Mountains of Arizona. Formerly this species had only been known from the two type specimens in the British Museum, described by Walker in 1853 from the west coast of Central America, and several soldier nymphs from Angel Guardia Island in the Gulf of Mexico, Lower California. A large series of soldiers from this colony in Arizona showed the characteristically long wing-pads (longer and with the traces of wing venation more distinct than in other species) which occurred on the species from Angel Guardia Island. Every specimen of a large series of all soldiers of this termite, including the types, shows these vestiges of wing-pads. This is very unusual, and is not true of the soldiers of any other species of termite; other *primitive* termites have occasional soldiers with wing-pads.

None of the *higher* more specialized termites have soldiers with wing-pads. It was thought some of these soldiers might be fertile Wheeler (1907) records workers and soldiers with vestiges of wings in ants; he terms them "pterergates." "The pterergate is a worker or soldier with vestiges of wings on a thorax of the typical ergate or dinergate form, such as occurs in certain species of *Myrmica* and *Cryptocerus*"—(Wheeler, 1913).

The fertility of these soldier termites—if it had been established—together with the vestigial wing-pads could be looked upon as evidence of a primitive ancestral condition, when all termites were winged and fertile. No fertile workers have as yet been found to occur among termites, nor any workers with wing-pads or vestigial wings. There is no definite proof that fertile termite soldiers occur despite the presence of soldiers with wing-pads, nor is any data at hand as to their progeny, although Heath (1903) has recorded fertile soldiers in the species *Termopsis angusticollis* Hagen that produced "normal progeny." In fact, recent histological work by Miss Thompson has definitely proved that soldiers with wing-pads are not fertile.

Attempts at Cross-Breeding.

In colonies of *Reticulitermes*, in logs in the forest, sometimes a male of the first form is found with numerous (as many as sixteen) mature females of the second form. Grassi would have described these second form females as "substitute" queens, produced by the workers to fill the place of a missing "true" first form, deälated queen.

It is an open question how they are to be accounted for with our present knowledge, as we have no exact data as to the progeny.

In another instance, three queens of the third form and one queen of the second form of a species of *Reticulitermes* were found together in the same colony. However, both sexes of two different mature reproductive castes have never been found in one and the same colony of a species of *Reticulitermes*.

On account of the lack of reliable data on the progeny of such reproductive forms—which undoubtedly were cross-breeding under natural conditions—as previously stated, (Thompson and Snyder, 1919), it was planned to undertake, with Miss Thompson, a thorough investigation of the termite castes, especially of the three stable reproductive types, with an analysis of their breeding, to be carried on by means of field and laboratory observations and by breeding experiments which would require several years to complete. A beginning was made in the spring of 1919 to cross reproductive forms of different types of *Reticulitermes flavipes* under artificial conditions. The following is a brief summary of these attempts:

Methods.

A large series of young second form female adults of *Reticulitermes flavipes*, which possibly may have been fertilized by second form males, were taken from a fairly small colony and placed with mature first form deälated males, which had not copulated, in small shallow cells in decayed wood sunken in moist sand in glass jars and tin boxes.

Results.

After a period of ten days to two weeks all these second form females had died, but the first form males were still living and were active; they evidently were prepared to forage for themselves, whereas the second form adults needed the care and nourishment usually afforded them by the workers. Possibly the jaw muscles in these young second form adults had begun to degenerate, through disuse in masticating wood, as happens later, (Thompson and Snyder, 1920). On account of lack of specimens and opportunity to collect others at the proper season, no further crossing was attempted. It is believed that second form males—like the females—would have succumbed, without the workers. Nevertheless, further efforts at crossing the different reproductive types will be made, with species of several genera.

Summary and Conclusions.

In the preceding pages, the three types of colonizing reproductive forms of termites, and the nymphs from which they develop, have been described; "intermediate" forms have also been discussed.

Data on the occurrence and habits of these different reproductive forms have been presented.

The different methods by which these three reproductive forms establish new colonies have been outlined and the progeny of these forms described.

The results of experiments in breeding and cross-breeding have been used to supplement observations on these reproductive forms made in the field.

It seems to the writer not unreasonable to conclude that the second and third reproductive forms, as well as the intermediates, in termites are mutations! They, so far as is known, breed true to type; in this case then, all the castes are mutations from the parent first form, and a plausible explanation for the phenomenon of polymorphism is afforded. As has been shown before, (Thompson and Snyder, 1919)—"A gradation of characters can be traced throughout the series." * * * "These castes might be interpreted either as gradations in a series of continuous or fluctuating variations, or as a series of regressive mutations, *i. e.*, mutations formed by the loss of characters, comparable to the series of mutations found in *Drosophila*." * * * "Should the former prove to be the case, then transitional or intermediate forms between the existing castes should be expected, but it must be remembered that mutations also may be arranged to form a structural series, even though they may not have originated in this order," (Thompson and Snyder, 1919). As has been shown, rather few intermediate forms have as yet been found.

The sterile worker and soldier (also nasuti) castes and colony life have existed among termites since the late Tertiary period, for these forms are found as fossils in gum copal, indicating an early development of polymorphism. However, the highly specialized different types of colonizing reproductive forms (with the exception of the winged first form) and the "intermediates" very probably have been evolved comparatively recently—in geological history—since the Tertiary period.

The three main evolutionary factors are Lamarck's factor of the origin of variations through environmental action; Darwin's the survival of chance variations, which are adapted to the environment; the DeVries' chance variations, *i. e.*, mutations, which may or may not be useful, *i. e.*, adapted to the environment.

A morphological study of termites indicates to the writer that certain structural peculiarities in case of the workers and soldiers, which appear to indicate adaptation to environment and as the result of use, are rather to be explained as chance variations which have survived through adaptation to environment, (Snyder, 1919).[1] The workers of certain species of subterranean termites living in the hard dry soil of the semi-arid southwestern states have the prothoracic tibiae enlarged, *i. e.*, subfossorial, and the enlarged legs might appear to be the result of use or response to environment. However, other termites living under the same conditions, have not the enlarged tibiae.

The highly specialized soldier caste is in certain species often of little apparent use to the colony life. There is great variation in the size and shape of both the mandibulate soldiers and the nasuti. In the case of species in the genus *Capritermes* Wasmann, the peculiar twisted shape of the mandibles of the soldier caste can certainly not be explained as a useful adaptation; the mandibles must be almost useless for the purpose of defense against marauding enemies of the colony.

It appears to the writer that the origin of the castes of termites can only be explained by DeVries' mutation theory. It will be remembered that mutations are chiefly of two kinds—progressive and regressive; progressive mutations possess new characters not present in the parents and regressive mutations are those which have lost some of the parental characters.

In termites, in addition to the worker, soldier, the three stable reproductive types, and the "intermediate" reproductive types, there are other forms which may be considered to be mutants. I have already discussed these forms in a previous paper, (Banks and Snyder, 1920):

> "Certain abnormalities have been noted, (Snyder, 1915) in the metamorphosis of the nymphs of the first form to the winged adult. Individuals

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[1] 1919. Snyder, T. E. Some significant structural modifications in Nearctic termites. Proc. Ent. Soc. Wash., Vol. 21, No. 5, May.

may be observed with partial pigmentation to the chitinized parts, but with the wings partially unfolded, or unfolded but crumpled wings, or merely the long opaque wing pads of the mature nymph before the last quiescent stage and molt. Other individuals that may have the mature body pigmentation, but distorted or poorly developed wings, or even wing-pads, emerge with the normal winged adults at the time of the swarm.

"It was formerly explained that these abnormally developed individuals were merely abnormalities due entirely to unfavorable conditions of moisture. Now, however, when considered with certain 'intermediate' forms, these abnormalities may be termed fluctuating variations or mutations from the normal winged reproductive forms, (Thompson and Snyder, 1919). These abnormal forms, together with the 'intermediate' forms represent almost a complete series beginning with normal wings and ending with the apterous reproductive form, a large intergrading series. On these intermediate forms the length of the wing pads ranges from the long wing pads of the nymphs of the first form to vestigial buds.

"These abnormalities and 'intermediates' have partial pigmentation to the body, and the intermediates have various stages of eye development, ranging from partial mature pigmentation to the eye to merely traces of the eye.

"In the forms which develop abnormally at the time of the quiescent stage and final molt of the nymph of the first form there are various forms which might be compared to the 'club,' 'vestigial,' and 'stumpy' wings of the mutants of *Drosophila melanogaster* (*ampelophila*).

"The writer has, unfortunately, only preserved a small series of these abnormalities which occur 'wild,' or in nature, as well as in rearing cages or artificial colonies; these are mostly females—5 females and 3 males."

It will be noted that there is not only much variation in the development of the eye of the intermediate reproductive adults (near the stable second form adults), but there is also much range in the intensity of body pigment.

To summarize, from the viewpoint of the mutation theory, all of these problems, involving the social system and the highly specialized castes, which can not be satisfactorily explained by the evolutionary theories of Lamarck and Darwin *can* be explained by DeVries' mutation theory. This is the view held by many modern workers.[1]

A similar view of the origin of castes is suggested in a more recent paper by Imms (1919).

The second and third reproductive forms would be chiefly progressive mutations, also the workers and the two types of soldiers; there has been a loss of characters. The workers and soldiers have also gained characters which are *often* useful, as seen in the legs, heads, mandibles and nasuti. Now a mutation is not necessarily useful, but a Darwinian variation must be useful.

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[1] 1903. Morgan, T. H. Evolution and adaptation. New York.

Other interesting "abnormalities" are the soldiers with wing-pads, a reversion to the ancestral winged condition.

Of course, when their origin is explained as mutations, the value of any of these castes to the colony life is not essential; indeed, they even may be a hindrance, provided their presence is "not entirely fatal to the community," (Morgan, 1903).

Imms (1919) states that the origin of the castes in termites may be explained by Mendelian inheritance.

It will readily be seen that my studies of the biology and breeding habits of the three types of reproductive forms are as yet incomplete. The results of the breeding and especially the cross-breeding experiments are, in general, unsatisfactory. Nevertheless, it is believed that, while these preliminary results of breeding and attempts at cross-breeding are not conclusive, they show the trend that future experiments should follow.

Future biological and histological studies should in time solve the problems.

Some of the especially important problems needing elucidation or confirmation are:

(1) More exact proof that the second and third reproductive forms breed true to type.

(2) The nature of the progeny of the "intermediate" reproductive forms.

(3) The methods of colonization of the second and third reproductive forms and whether they can survive without workers.

(4) The exact number of molts undergone by each caste and the accompanying external and internal changes that occur at the time of the molt or between molts, as the increase in the number of antennal joints, etc. (The growth of the latter, however, apparently has no relationship to the time and number of molts that take place.)

(5) Studies of the third reproductive form in the more primitive termites, as *Termopsis*, *Neotermes*, etc.

(6) Proof of the apparent absence of the third form reproductive type in the higher, more specialized termites (of the family *Termitidae* Bks.) and also that of the second form reproductive type in some genera of the higher termites (as in species of *Nasutitermes* Bks.).

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A NEW TROPICAL WEEVIL FROM FLORIDA AND CUBA.

By H. S. Barber.

A three week's vacation (in February and March, 1919) was spent by Mr. E. A. Schwarz and the writer, collecting in the southern part of Florida, most of the time at Paradise Key, which the Florida Federation of Women's Clubs is seeking to preserve as the "Royal Palm State Park."* One day's collecting on Big Pine Key (about 30 miles from Key West), and another day at Marathon on Vacas Key (18 miles further east) added several forms not found by us at Paradise Key, and brought the number of species of beetles we had brought together in this short expedition to well above 500. Among them are several forms previously known only for Cuba, and the probability that a considerable percentage of the species inhabiting the Southern Everglades have been described from the West Indies, greatly complicates the task of identifying the unfamiliar forms. In fact the most interesting part of the beetle fauna of the Everglade Keys and the Outer Keys is identical with that of the West Indies. The species here described is an example of this difficulty. Belonging to a genus quite numerous in species throughout the American tropics, though not previously known to occur naturally within our boundaries, and supposedly breeding in certain epiphytal plants of the treetops in the jungle-like "hammocks," the probable wide range of the species immediately confronts us and in spite of a search through the available literature dealing with South American forms, the possibility must remain that it may have been missed among the old species listed under *Sphenophorus*. Among its congeners in the National Collection the present species is remarkable for its small size, brilliant color, and absence of any external sexual character usual in the genus. It is with much pleasure that this beautiful species is named in honor of its first finder on our mainland, Mr. C. A. Mosier, the warden of the Royal Palm State Park, whose great interest in the study and preservation of the tropical natural history of his region has revealed so many forms hitherto unknown within our geographical limits and whose many personal kindnesses helped greatly in our comfort and collecting ability during our work on Paradise Key.

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* Since the construction of the automobile road towards Cape Sable has made the region easily accessible, Paradise Key has very justly attracted much attention and we were greatly assisted in our field work by having previously read the several botanical papers by Dr. J. K. Small (Journ. N. Y. Bot. Garden, 1916, 1917, and 1918), narrating his experiences here and throughout the region; and partly familiarizing us in advance with the flora we were to encounter. See also the preface to Small's "Ferns of Royal Palm Hammock;"—Snyder's description of the locality in these Proceedings (Vol. 19, p. 143, pl. 15 and 16); and Safford's "Natural History of Paradise Key —" (Smithsonian Report, 1917, pp. 377–434, 64 plates).

Metamasius mosieri, new species. (Plate 8.)

Small: alutaceous except head, rostrum, antennae, legs, metasternum and median half of underside of abdomen which are shining; black, except most of pronotum, metathorax and basal half of elytra which are bright red. Length 6.5–9.0 mm.; width 3.0–3.6 mm. Habitat Florida and Cuba.

Rostrum about three-fifths as long as pronotum in ♀, slightly more than half in ♂, moderately curved, feebly compressed, impunctate in apical third, becoming sparsely punctate towards base; base feebly dilated above antennal sockets which are almost contiguous to the margin of the eye; gular peduncle narrow, compressed, and strongly dentiform anteriorly. Prothorax nine-tenths as wide as long, impunctate or very minutely and sparsely punctuate on disc, a few scattered punctures before base and in the subapical constriction; strongly but sparsely punctate below; the bright sanguineous color of the pronotum extends down the sides half way to the coxae, but leaves the apical margin narrowly bordered with black, and a broader bilobed black border at base. Scutellum narrow, flat, impunctate, black. Elytra finely striate with fine, deep, widely distant, strial punctures; intervals flat and impunctate except for a median series of very fine, close set, almost obsolete punctures; basal half sanguineous, each elytron with a small round, antemedian black spot between third and sixth stria, which is obscurely connected to the black apical area on two specimens, these two also displaying a small faint posthumeral macula. Pygidium deeply, moderately densely punctate, apex broadly rounded in ♂, much narrowed in ♀. Metasternum sanguineous except small infuscate areas near middle of hind coxae; metepisternum rufous at middle the anterior and posterior ends black. Metanotum and dorsal portions of abdomen under the wing covers yellow. An internal segment protruding under the raised pygidum in three females is testaceous, sulcate (almost cleft) medially at apex, laterally coarsely punctured and with fine, sparse hairs.

Type and paratypes No. 22768, U. S. National Museum.

Described from five specimens:—A male collected at Cayamas, Santa Clara Province, Cuba, May 8, 1904, by E. A. Schwarz, and four females collected on Paradise Key, Florida (Type locality) November 10, 1917 (C. A. Mosier) February 19, 1919 (H. S. Barber) December 10, 1919 (C. Ikey Mosier) and January 8, 1920 (Graham Fairchild).

One of the specimens was beaten from a fern growth near the crown of a cabbage palmetto, and another was found high in an oak tree. The multitude of Orchids, Bromeliads, and other epiphytic plants on the branches of the hammock trees offers a difficult problem in the determination of the breeding habits of this beautiful little species, and all our attempts were futile with the possible exception that the old dead basal core of one of the large Bromliads (probably *Tillandsia utriculata*) was found displaying such exit hole and larval gallery as should be expected for this species, but no fragments of larval skin could be found. The quarantine against the related pests of sugar cane, banana, pineapple, and palms, certain of which (*Metamasins sericeus*, *Cosmopolites sordidus*) have been intercepted (although *C. sordidus* had already become established at Miami, Fla.), makes this apparently indigenous species of special interest and it remains to be seen whether or not it will, with the utilization of the Everglades, adopt an economic host plant.

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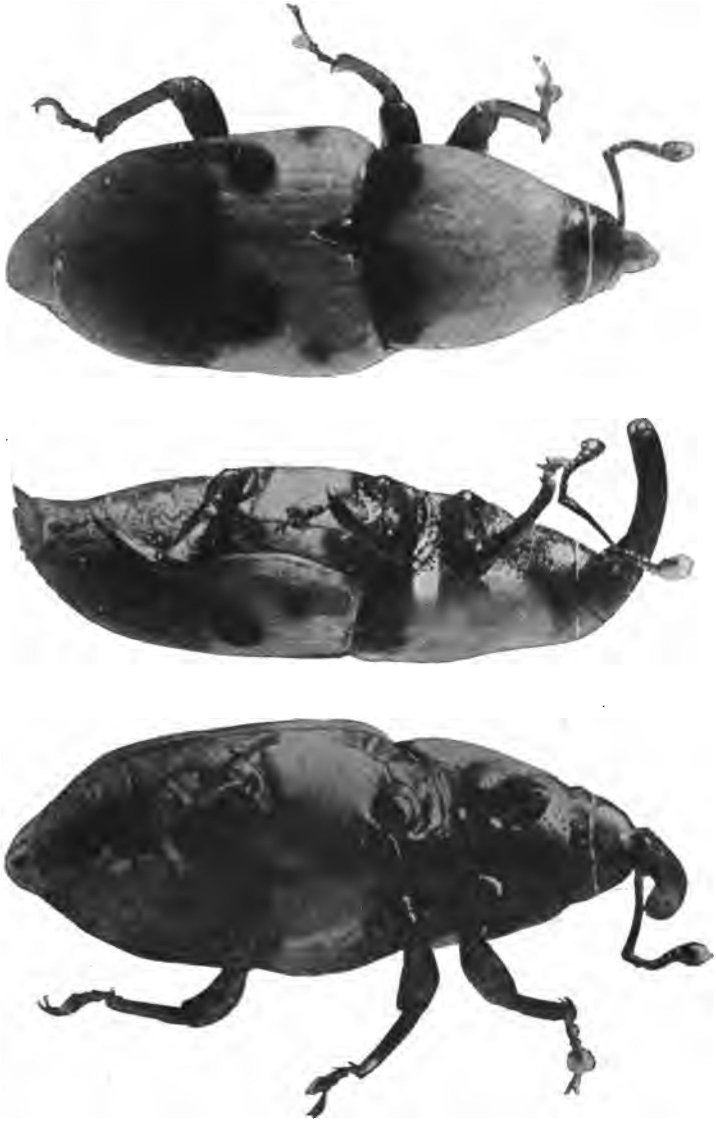

METAMASIUS MOSIERI BARBER × 10—FLORIDA AND CUBA

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A NEW GENUS AND SEVERAL NEW SPECIES OF CERAMBYCIDAE. (COL.)

By W. S. Fisher, *U. S. Bureau of Entomology.*

In working over the coleoptera received from the field men of the Branch of Forest Insects, U. S. Bureau of Entomology, during the past year, the following apparently new species of Cerambycidae were found. For one of these, a species from Arizona, the larva of which lives in the branches of *Canotia*, it was found necessary to erect a new genus.

All types and specimens mentioned are deposited in the U. S. National Museum at Washington.

Anoplocurius, new genus.

Maxillary and labial palpi about sub-equal in length; last joint oblong sides nearly parallel, truncate at apex. Ligula membranous. Antennal tubercles not prominent, contiguous. Head transverse; eyes large, coarsely granulated, deeply emarginate. Antennae, of the male, one and two-thirds times as long as the body; of female, about sub-equal in length to the body; twelve-jointed. Prothorax longer than wide, cylindrical. Scutellum wider than long, rounded posteriorly. Elytra distinctly wider than prothorax, without eburneous spots; sides parallel; apices separately rounded. Prosternum very narrow between the coxae. Anterior coxal cavities strongly angulated, open behind. Intermediate coxal cavities angulated and closed externally. Femora moderately clavate, slightly flattened, not dentate beneath. Tibiae slender, not carinate longitudinally, with two equal spines at the apex. First joint of posterior tarsi as long as the two following joints united. Body narrow, linear, somewhat flattened, first abdominal segment as long as the two following segments united.

Genotype.—Anoplocurius canotiae Fisher.

The species for which this genus is founded has the general aspect of the genus *Curius* and some of the small species of *Elaphidion.* From the former it is easily distinguished by not having a tooth on the femur, and from both of these genera by having a twelve-jointed antennae.

This new genus belongs to LeConte and Horn's tribe *Cerambycini,* and to Lacordaire's group *Callidiopsides,* but it seems to be one of the new discoveries which do not fit well in any of the proposed groups.

Anoplocurius canotiae, new species.

Male.—Unicolorous brown, shining. The sculpture of the head and prothorax consisting of intervening lines forming a fine network; surface sparsely clothed with long flying hairs. Prothorax with sides parallel to the posterior third then obliquely narrowed to the base. Antennae filiform, not carinate and without spines; first joint with the sculpture similar to the prothorax, one-half as long as the third, slightly clavate and arcuate; second joint very small, wider than long; third and following joints nearly equal in length; joints three to twelve finely punctate, rather densely pubescent, with some longer hairs on the inner side. Elytra about three times as long as the prothorax; sides parallel; coarsely but not densely punctate over entire surface, from each puncture arises a short white semi-erect hair. Underside of head in front, and posterior part of prosternum with irregular transverse striae. Metasternum and abdomen sparsely punctate, and sparsely clothed with long white recumbent hairs. First ventral abdominal segment with a large broad swelling on the median portion, of which the apical margin is clothed with a series of long erect hairs. Legs feebly pubescent with short hairs intermixed with longer erect ones. Hind femora extending to the middle of the fourth ventral abdominal segment.

Length 7 mm., width 1.5 mm.

Female.—Differs from the male in having the third antennal joint about one-half as long as the first and with a short spine at the apex; fourth joint three-fourths as long as the third; joints four to eleven gradually decreasing in length; joint twelve one-half as long as the eleventh. Hind femora extending to the fourth ventral abdominal segment. First ventral abdominal segment smooth at middle without any protuberance.

Length 7 mm.; width 1.5 mm.

Type Locality.—Cotton City, Arizona. Elevation 1400 feet. Mr. Geo. Hofer, collector.

Other Localities.—Sabino Canyon, Arizona.

Type.—Cat. No. 22821, U. S. Nat. Mus.

Described from 25 specimens, eleven males and fourteen females, recorded under Bureau of Entomology number, Hopk. U. S. 10087e. Specimens reared from material collected March 12, 1919, by Mr. Geo. Hofer from dead branches of *Canotia* and submitted with the following note: "Larvae removed from between the bark and wood and from the heartwood of dead branches of an unknown bush, which occurs on the edge of a strip of desert near Cotton City." The plant has been identified by Dr. Paul Standley, Botanist of the Smithsonian Institution as *Canotia holacantha* Torrey. Another male specimen in the collection was collected August 31, 1919, by Geo. Hofer, at Sabino Canyon, Arizona, at light.

Callidium pseudotsugae, new species.

Male.—Oblong, dull black throughout above; beneath, legs and antennae shining black, with a faint bluish reflection; parallel; pubescence erect, black and bristling from the head and prothorax laterally, almost wanting and extremely short on the elytra. Head coarsely and confluently punctate, punctures coarser and more distinct between the eyes; median line finely impressed. Antennae as long as the body; first joint twice as thick as the following joints and two times as long as the second; joints one to four strongly incrassated at apex; second joint a little more than half as long as the third; tenth and eleventh joints sub-equal in length; last joint rather broadly rounded at apex, not appendiculate. Prothorax transverse, two-fifths wider than long, slightly wider than the elytra, widest at about the middle; sides strongly, evenly rounded, rather roundly converging towards apex, more rapidly converging and rounded from a little behind the middle to the very fainty subtubulate base; surface with the lateral parts very densely and deeply punctured and separated from the median impressed part, with coarse but very shallow punctures, by a well defined and abrupt line, which has a well marked sinus just behind the middle. Elytra three and one-half times as long as the prothorax; sides parallel, obtusely rounded at apices; surface alutaceous, coarsely irregularly punctured, margins of punctures indefinite, with minute setose punctures in their depth. Scutellum nude, very obtusely and broadly ogival; surface broadly concave. Prosternum densely and deeply punctured over entire surface, similar to the lateral part of prothorax. Beneath moderately punctured and sparsely clothed with long erect blackish hairs. Femora strongly swollen. Tibiae arcuate.

Length 10–13 mm.; width 3.5–4.5 mm.

Female.—Differs from the male in having the antennae only two-thirds as long as the body. Prothorax as wide as the elytra with the median part not impressed and the entire surface uniformly punctured with coarse but very shallow punctures. Prosternum finely, sparsely and transversely punctato-rugose, shining. Femora and first antennal joint not as strongly swollen as in the male.

Length 10–12 mm.; width 3.5–4.5 mm.

Type Locality.—Wright, California. F. B. Herbert, collector.

Other Localities.—Big Basin, Santa Cruz Mountains, California. T. E. Snyder, collector; Santa Clara Co., Calif. (Coquillett); Oregon (Hubbard and Schwarz).

Type.—Cat. No. 22822, U. S. Nat. Mus.

Described from fifteen specimens. Nine males and two females, recorded under Bureau of Entomology number, Hopk. U. S. 14483a and reared from material collected by Mr. F. B. Herbert in wood of Douglas fir (*Pseudotsuga taxifolia*). Three males and one female recorded under Bureau of Entomology number, Hopk. U. S. 15190, collected June 13, 1917, by T. E.

Snyder on freshly cut branches of Douglas fir (*Pseudotsuga taxifolia*). In the collection there is also a specimen labeled "Oregon, Coll. Hubbard & Schwarz," and another labeled "Santa Clara Co., Cal., Collection Coquillett."

This species falls in the group where the antennae differs considerably in length in the sexes and having the line separating the median and lateral parts of the prothorax well marked. It is closely allied to *antennatum* Newm., but differs from that species by having the upper surface entirely black.

Callidium sequarium, new species.

Male.—Oblong, black throughout above, shining, parallel, pubescence erect, black and bristling from the head and prothorax laterally, almost wanting and very short on the elytra. Head coarsely and densely punctured over entire surface; median line slightly impressed in some specimens, absent in others. Antennae two-thirds as long as the body; first joint not quite two times as thick as the following joints; joints one to four strongly incrassated at apex; second joint half as long as the third; joints ten and eleven about sub-equal in length; last joint broadly rounded at apex, not appendiculate. Prothorax not quite as transverse as in *pseudotsugae*, narrower than the elytra, one-fourth wider than long; widest just in front of middle; sides strongly rounded, roundly converging towards apex, more rapidly converging and rounded from about the middle to the base, which is not at all constricted or subtubulate; surface coarsely, deeply and closely punctate, the punctures becoming deeper and more rugose, although only a little less shining, at sides; the abrupt line separating the median and lateral areas scarcely traceable. Elytra three and one-half times as long as the prothorax; sides parallel, obtusely rounded at apices; surface very coarsely, deeply and densely punctate, the punctures distorted and without well defined margins, the minute setose punctures in their depths not as well defined as in *C. pseudotsugae*. Scutellum broadly and obtusely ogival, surface coarsely punctate. Prosternum very coarsely and deeply punctured, with a transversely and obtusely angulate rugose area before the coxae, and another similar area along the anterior margin, the punctures distinctly separated and well defined. Beneath black without any bluish reflections, shining; surface moderately punctured and sparsely clothed with long semi-erect hairs. Femora strongly swollen. Tibiae arcuate.

Length 11 mm.; width 3.5 mm.

Female.—Differs from the male in having the antennae only one-half as long as the body with the joints not quite as strongly swollen. Prothorax with the densely punctured lateral area more shining, the punctures finer, more confluent and less deep. Prosternum very finely, sparsely and transversely punctato-rugose, shining. Femora not as strongly swollen as in the male. Tibiae scarcely arcuate.

Length 11–12 mm.; width 4–4.5 mm.

Type Locality.—Giant Forest Calif., F. C. Craighead, collector.

Type.—Cat. No. 22823, U. S. Nat. Mus.

Described from seven specimens, two males and five females, recorded under Bureau of Entomology number, Hopk. U. S. 10651p, and reared from material collected by Mr. F. C. Craighead, June 29, 1918, under bark on fallen limbs of Big Tree (*Sequoia washingtoniana*).

In general form this species resembles *janthinum* Lec., by having the antennae apparently differing but little sexually, and the median and lateral parts of the prothorax not separated by a distinct line. It differs from that species, however, by having the entire surface of a shining black color.

Callidium juniperi, new species.

Male.—Form elongate, greenish cyaneous and strongly shining above; beneath, legs and antennae piceous black, shining with a slight metallic reflection; pubescence semi-erect, black and rather long on the head and prothorax, almost wanting and extremely short on the elytra. Head coarsely, deeply and confluently punctured over the entire surface; median line finely impressed between the antennal tubercles. Antennae three-fourths as long as the body; first joint not much thicker than the following joints; joints one to four strongly incrassated at apex; second joint about one-half as long as the third; tenth joint two-thirds as long as the eleventh, which is abruptly pointed at apex. Prothorax moderately transverse, about as wide as the elytra, one-half wider than long, widest at the middle; sides rather evenly and strongly rounded, a little more rapidly converging to the base, which is not subtubulate; surface with the punctures coarse, deep and close-set, becoming more rugose though only a little less shining at the sides; the abrupt line separating the median and lateral areas not traceable. Scutellum broadly rounded at apex; surface broadly concave. Elytra nearly four times as long as the prothorax; sides distinctly narrowing from base to the very broadly rounded apices; surface coarsely, deeply and densely punctate throughout, the punctures irregular and polygonally crowded, without well defined margins and with minute setose punctures in their depth; intervals shining, nearly smooth, becoming a little more rugose towards the apex. Prosternum very coarsely and deeply punctured, with a transversely and obtusely angulate rugose area before the coxae, and a narrow, nearly smooth area along the anterior margin. Femora more gradually swollen than in *C. pseudotsugae*. Tibiae arcuate.

Length 10 mm.; width 3.2 mm.

Female.—Differs from the male in having the antennae only a little more than one-half as long as the body, with the last joint appendiculate. Prothorax with the lateral areas more densely and finely punctate, the punctures more confluent and less deep than in the male. Prosternum very finely, sparsely and transversely punctato-rugose, shining. Femora less strongly swollen.

Length 11 mm.; width 3.2 mm.

Type Locality.—Maxwell, New Mexico. D. J. Caffrey, collector.

Type.—Cat. No. 22824, U. S. Nat. Mus.

Described from five specimens, three males and two females, collected by D. J. Caffrey, July 21, 1916, under bark of Cedar (*Juniperus* sp.).

Two of these paratypes, male and female, differ from the type in being much smaller, only measuring 7 mm. in length. This is probably due to the lack of food, causing the larvae to pupae prematurely, which is often the case in the family Cerambycidae.

This species belongs to the group, including the species which have the antennae and prothorax differing very little in the sexes. It can be easily distinguished from any of these species by its wedge-shaped form, the elytra being distinctly narrowed from base to apex.

Ataxia arizonica, new species.

Elongate, parallel, piceous black, sparsely clothed with recumbent whitish and brownish ochreous pubescence, tending to form irregular, indistinct lines on the elytra, with rather thick, semi-erect black setae arising from the elytral punctures. Head finely, densely punctate, with a few coarser and deeper scattered punctures intermixed, about as wide as long, feebly convex in front and moderately impressed between the antennal tubercles. Antennae nearly one and one-half times as long as the entire body (♂), about as long as the body (♀); first joint four-sevenths as long as the third, clavate; joints three and four sub-equal in length; joint five a little longer than four and sub-equal in length to the seventh, eighth and eleventh; ninth and tenth joints a little shorter than the eleventh; the joints very feebly annulated at base, densely pubescent, with fine, short, whitish and brownish hairs intermixed with long, sub-erect ones. Prothorax about as wide as long, feebly narrower at base than apex; sides slightly arcuate with a feeble tubercle at middle; surface densely punctate with a few larger punctures intermixed, pubescence dense, nearly concealing the surface sculpture, except an elongate space at the middle, which is denuded. Elytra three times as long as the prothorax and only a little wider than it at the base; humerals rounded; sides nearly parallel; apices sub-truncate; surface with rows of irregular, moderately coarse punctures, becoming coarser and more confused behind the scutellum. Scutellum triangular, rounded behind, pubescent. Beneath and legs densely clothed with white and ochreous pubescence. Front coxae angulated, closed behind, and moderately separated.

Length 10–12.5 mm.; width 2.2–3 mm.

Type Locality.—Sabino Canyon, Arizona, Geo. Hofer, collector.

Other Localities.—San Simon, Arizona, Hubbard and Schwarz, collectors.

Type.—Cat. No. 22825, U. S. Nat. Mus.

Described from ten specimens, four males and six females. Nine of these specimens were collected by Geo. Hofer at light between May 28 and August 10, and the other specimen was collected by Messrs. Hubbard and Schwarz, on July 5th.

This species is allied to *crypta* Say, but is easily distinguished from that species by being more parallel, pubescence more distinctly variegated with white and ochreous hairs, and by having the antennae not distinctly annulated.

COLEOPHORA NOTES WITH DESCRIPTION OF TWO NEW SPECIES (LEPID.).

By CARL HEINRICH, *Bureau of Entomology.*

Coleophora occidentis Zeller.

Dyar Cat. No. 6034.

Zeller describes the larval case of *occidentis* as very similar to that of the European *nigricella*. This would indicate that it is a good species and should be removed from its present position as a synonym of *pruniella* Clem. The larval case of the latter as described by Miss Braun (Cin. Soc. Nat. Hist. XXI, No. 4, p. 157, 1914) is of quite a different structure, resembling that of *leucochrysella* much more than it does *nigricella*.

Coleophora acamtopappi Busck.

Busck. Proc. Ent. Soc. Wash., Vol. 17, p. 87, 1915.

Busck described this species from adults only. We have since received two reared specimens from H. Jobbins-Pomeroy with larval cases. The larval case is very striking and the longest yet recorded from North America. It is white; cylindrical; 25 to 28 mm. long by 4 mm. thick; tapering slightly to posterior end, which is triangularly compressed; mouth deflecting to 45 degrees. The larvae were taken feeding on Coreopsis species, Havana, Ill., moths issuing in June. Busck's type was reared from Acamtopappus from Los Angeles Co., Calif.

Coleophora astericola, n. sp.

Labial palpi grayish fuscous streaked with white above and below; second joint tufted. Antennae white faintly annulated with pale gray-brown; basal joint slightly thickened with appressed, glossy gray-brown scales, not tufted. Face, head and thorax glossy, gray-brown with narrow borders of white above the eyes and antennae and along the inner margins of the patagia. Fore wings dark grayish brown with two longitudinal white stripes, one on costa from base to middle, the other extending along the lower vein of the cell, and disappearing towards tornus; a few blackish scales scattered over the wing; cilia concolorous with wing, somewhat marked with white scales at tornus. Hind wings dark grayish brown; cilia concolorous. Abdomen pale glossy gray-brown. Legs white, longitudinally banded on outer sides with grayish fuscous.

Alar Expanse.—13 mm.
Locality.—Boston, Mass.
Food Plant.—*Aster multiflorus.*
Type.—Cat. No. 22806, U. S. N. M.

Described from a single female reared September 20, 1920, by August Busck, from larva taken feeding on Aster multiflorus. This species is nearest to *C. infuscatella* Clemens, but separable from it by having two, not four, longitudinal white stripes on the forewings.

The larval case is grayish white, of silk, evenly and entirely covered with small particles of sand (possibly an accidental accretion from the rearing jar); cylindrical; slender and slightly tapering toward posterior end; 13 mm. long by about 2 mm. thick at the widest part just before middle; posterior end rounded and flatly compressed; mouth deflected to 45 degrees.

Coleophora veroniaeella Chambers.

Dyar Cat. No. 6051.
Braun. Ent. News, Vol. 23, p. 163, 1912.

This species was described by Chambers from larval cases taken on Vernonia. Miss Braun later reared and described the moths. During 1914 I found cases answering Chambers' description very abundantly on a species of swamp Helieanthus in a low, shaded, damp piece of woodland at Falls Church, Va. The moths reared from these proved to be Chambers' species. Larvae were taken feeding in May and adults issued June 24 to July 10. The nearest iron weed (Venonia) is about a mile distant but to date I have not found any larval cases on it. As there is no doubt as to the identity of the adults, both plants must be regarded as food plants.

Coleophora tiliafoliella Clem.

Dyar Cat. No. 6048.
Kearfott. Can. Ent., Vol. 36, p. 324, 1904.

Kearfott describes the moth reared from cases collected at Ottawa, Canada, as having white scaling on and below the costa of forewing. Specimens in U. S. N. M. (reared by Wm. Wild, from Gowanda, N. Y.) show no such white markings, which would indicate that there are two pistol case feeders on Tilia, or that the species is more variable than others in this genus. The cases, however, agree in every detail with Clemens' description. To date I have not been able to locate Kearfott's specimen.

Coleophora atromarginata Braun.

Braun. Cin. Soc. Nat. Hist., Vol. 21, p. 166, 1914.

Syn.—C. curructpennella Walsingham (nec Zeller). Trans. Ent. Soc. Lond., p. 430, 1882.

Dyar Cat. No. 6014.

This is our common oak-feeding pistol case bearer which Walsingham and others have identified as the European *C. curructpennella* Zell. It is somewhat variable in size, ranging anywhere from 10.5 to 14.5 mm. Miss Braun's description was drawn from a unique and rather small specimen. The average size is about 13 mm. alar expanse. There are consistent differences both in larval cases and adult moths between our American species and the true *curructpennella.* In the latter the flaps of the cases are as a rule larger and more delicate and the upper edge of the barrel is rougher, containing one or more projections. In the American species the barrel is smooth. In *curructpennella* the yellow stripes on the forewings of the moth are continuous from the base of the wings, while in *atromarginata* more than half the wing from the base is white without appreciable markings, the yellow stripes becoming indistinct only in the apical portion where they shade into a dark brown at the tip. The name *curructpennella* should be dropped from our lists as this form does not occur in the United States.

Coleophora atlantica, n. sp.

Palpi white faintly streaked with golden brown above; second joint tufted. Antennae white faintly annulated beyond second joint with light golden brown; base covered above by large white projecting tuft; under side of tuft shaded with pale golden brown. Face, head and thorax silvery white. Fore wings silver white, lightly irrorated beyond middle with brownish scales; costal cilia white; cilia at apex pale, dull fuscous; dorsal cilia grayish golden. Hind wings lead gray, cilia concolorous with a somewhat more golden fuscous tinge on dorsum near apex. Abdomen white dusted with fuscous; anal tuft silvery white. Tips of tarsi faintly annulated with golden brown.

Alar Expanse.—11–15 mm.

Locality.—Eastern U. S. (Type locality, Falls Church, Va.)

Food Plant.—Prunus serotina.

Type.—Cat. No. 22805, U. S. N. M.

Described from six reared and four collected specimens (males and females) from Falls Church, Va. (Heinrich reared, five specimens from *Prunus serotina* under Hopk. U. S. Nos. 11135a, 12127a, and 13432a; June 7 to July 3), East Aurora, N. Y. (Wm. Wild, reared one specimen July 14), Washington. D. C. (August Busck, one specimen, July), Oak Station, Pa. (Fred. Marloff, one specimen, July 1), Trenton, Ontario, Canada. (Evans, two specimens, June 21 and July 14). This is the species wrongly identified by Kearfott as *C. pruniella* and so listed in the New Jersey list. It is very close to *C. sacramenta* Heinrich. In fact, for a long time I thought that the California pest on cultivated plum might be our eastern wild cherry feeder that had been carried west on nursery stock. The cases of the two, however, are enough different to forbid us placing them under one name without more definite evidence. In the adult of *atlantica* the dark shadings on the under side of the antannal tuft and at the outer margin of the apical cilia of the forewings are paler than those of *sacramenta*.

The larvae feed externally on the leaves of the wild cherry and during April and May their cases are quite abundant locally about Washington. The case is of the "pistol" type, black, with the flaps rather small and closely appressed; the mouth deflected to about 45 degrees and the posterior end evenly rounded giving the "pistol handle" a rather small and tightly curled appearance; length of case 6 to 8 mm.

BUMBLEBEES OF DISTRICT OF COLUMBIA AND VICINITY.
(Hym., Bremus.)

By L. O. Jackson.

The region covered by this paper is the same as that of several local lists on the fauna and flora of the District of Columbia and vicinity, being the area within a radius of fifteen miles from the Capitol. Great Falls and Mount Vernon, Va., are about the northern and southern, and Beltsville, Md., and Dunn-Loring, Va., the eastern and western limits, respectively.

This list comprises records of several years collecting in this locality and contains a key for the separation of the species found here. Under the annotated list will be found the records of earliest and latest date of capture of each sex of the several species. In this connection the observations of another writer on one of the included species may be of interest.

Frison[1] says that at Champaign, Ill., *auricomus* queens began to fly about the 12th of May. Under artificial breeding conditions the first worker emerged July 20, with five more by July 25. Under more natural conditions the preceding year, a worker was found June 24, and "judging from the ——— appearance of the worker, the worker had only recently appeared."[2] In the last paper cited, the first male emerged July 22. With us, the earliest record for queens is April 6, with several for the end of April (28–30), and the first collected record for males is July 14.

[1] T. H. Frison. Ann. Ent. Soc. Am., Vol. XI, 1918, p. 43.

[2] Ibid., Vol. X, 1917, p. 278.

In determining the sex of bumblebees I have found the shape of the tarsal claws, first noted by E. T. Cresson,[1] to be very convenient. The claws are bifid in both sexes, but in the females (queens and workers) the inner tooth is short, usually not more than half the length of the outer, though occasionally somewhat more, but always shorter than the outer. In the males, on the other hand, the outer and inner teeth are of equal length. It is as though, in the females, the claw had been cut from the inside, short of the apex, while in the males, it had been cut, split, rather, from the very tip. This character holds good for all species I have examined. Unfortunately there is no way known at present to distinguish workers from queens, save relative size, the workers always being smaller. But in some cases it is a question whether the specimen is a small queen or a large worker.

This paper is based on specimens brought together by numerous collectors, in addition to the writer. The material is chiefly in the collections of the National Museum, the Biological Survey and the author.

The species occurring in this vicinity may be separated by the following keys.

Queens.

1. Interaler band or black hair between the wings........................7
   No interaler band..2
2. Lower half of pleura black..................................*perplexus*
   Pleura yellow to bases of legs.................................3
3. Abdomen with more than half the second segment yellow..............5
   Abdomen with not more than half the second segment yellow...........4
4. No yellow pile beyond the first segment.....................*impatiens*
   Some yellow pile on second segment, never more than half....*bimaculatus*
5. Malar space distinctly longer than it is wide at apex.............*vagans*
   Malar space not distinctly longer than it is wide at apex...............6
6. Ocelli large, placed well below supraorbital line, lateral ocelli nearer the eye margins than to each other..........................*separatus*
   Ocelli small, near supraorbital line, lateral ocelli not nearer the eye margins than to each other.................................*affinis*
7. Abdomen with first four dorsal segments yellow.................*fervidus*
   Not so colored..8
8. First two dorsal abdominal segments yellow...................*fraternus*
   Usually with yellow pile on first three segments, first sometimes black...9
9. Ocelli large, placed well below supraorbital line................*auricomus*
   Ocelli small, placed near the supraorbital line............*pennsylvanicus*

Workers.

1. No interaler band..2

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[1] Proc. Ent. Soc. Phil., Vol. II, 1863, p. 84.

Interaler band present, more or less distinct........................6
2. Pleura with lower half covered with dark pile................*perplexus*
Pleura covered with yellow pile to bases of legs........................3
3. Ocelli large, placed well below the supraorbital line, lateral ocelli nearer the margins of the eyes than to each other................*separatus*
Ocelli small, near supraorbital line, lateral ocelli not nearer margins of eyes than to each other..4
4. Malar space wider at apex than long........................*impatiens*
Malar space as long or longer than width at apex....................5
5. Hypopygium with median carina on apical portion, second segment yellow..*vagans*
Hypopygium with no median carina, usually some black on second segment..*bimaculatus*
6. Ocelli large, placed well below supraorbital line, lateral ocelli nearer the margins of the eyes than to each other........................7
Ocelli small, near supraorbital line, lateral ocelli not nearer eye margins than to each other..8
7. Not more than first two dorsal abdominal segments with yellow pile..*fraternus*
Usually with yellow pile on first three segments, first segment sometimes entirely dark..*auricomus*
8. Second segment with brownish red pile........................*affinis*
Second segment yellow..9
9. Only first three segments with yellow pile................*pennsylvanicus*
First four segments with yellow pile........................*fervidus*

Males.

1. Eyes swollen, ocelli well below supraorbital line......................2
Eyes not swollen, ocelli on or near supraorbital line..................4

2. Malar space a mere line..*fraternus*
Malar space one-third as long as wide..........................3
3. More than first two dorsal abdominal segments covered with yellow pile..*auricomus*
Not more than first two segments with yellow pile............*separatus*
4. Interaler band present[1]..5
No interaler band, at most a few black hairs on disk................7
5. Third dorsal abdominal segment black........................*affinis*
Third dorsal adbominal segment yellow..........................6

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[1] Mr. J. C. Crawford tells me that some western specimens of *pennsylvanicus* have the interaler band almost totally lacking. Should such specimens be found here they may be readily distinguished from *perplexus*, where they would run in this key, by having yellow pile on first four segments of abdomen.

6. Apex of abdomen black; all tibiae black, except posterior pair on inside; never much black pile on scutellum........................*fervidus*
Apex of abdomen usually with some ferruginous pile; some of tibiae usually with more or less ferruginous hair; yellow pile of scutellum often with strong admixture of black hair..................*pennsylvanicus*
7. First three dorsal abdominal segments yellow.................*perplexus*
Some black pile on third dorsal abdominal segment...................8
8. Only the first segment with yellow pile......................*impatiens*
Second segment with more or less yellow pile.........................9
9. Always some black pile on second segment.................*bimaculatus*
Second segment entirely yellow...................................*vagans*

For complete descriptions of the following species the reader is referred to the "Bombidae of the New World," by Henry J. Franklin.[1]

Annotated List of Species.

1. **Bremus affinis** (Cresson).

This is one of the rare species in this region. The following are the only records I have after five years collecting:

Queens, April 30, 1916 (Maryland, near Plummer Id., on flowers of *Glechoma hederacea*, H. L. Viereck; Virginia, near Plummer Id., Md., flowers of *Mertensia virginica*, L. O. Jackson).
June 28, 1917 (Beltsville, Md., on flowers of *Xolisma ligustrina*, L. O. Jackson).
September 5, 1915 (Maryland, near Plummer Id., L. O. Jackson).
Workers, July 1, 1915 (Plummer Id., Md., W. L. McAtee).

2. **Bremus bimaculatus** (Cresson).

A common species throughout the summer. The earliest and latest dates of the capture of the three sexes are as follows:

Queens March 31, at Mt. Vernon, Va., on flowers of *Salix searicea* (W. L. McAtee).
July 16, at Dyke, Va., on flowers of *Pontederia cordata* (W. L. McAtee).
Workers June 4, at Mt. Vernon, Va., on flowers of *Diospyros virginiana* (W. L. McAtee), and Beltsville, Md.
Sept. 12, at Beltsville, Md.
Males July 4, at Virginia near Plummer Id. (H. L. Viereck).
Aug. 1, at Mt. Vernon, Va.

I have the following flower records for this species, but it must be remembered that this data is incomplete. Bumblebees are apt to visit almost any flower.

Pontederia cordata
Salix sericea
Xolisma ligustrina
Diospyros virginiana

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[1] Trans. Am. Ent. Soc., Vol. 38.

Brassica sp. *Hydrophyllum* sp.
Azalea nudiflora

3. **Bremus impatiens** (Cresson).

Common throughout the summer. The workers of this species are extremely variable in size, the smallest bumblebee I have ever taken (8 mm.) belonging here. This species and vagans are perhaps the most abundant of local forms.

Queens	April 16, at Mt. Vernon, Va. (W. L. McAtee).
	May 28, at Dyke, Va.
Workers	June 30, at Eastern Branch, near Bennings, D. C.
	Oct. 11, at Spring Hill, Va.
Males	July 12, at Plummer Id., Md.
	Oct. 28, at Cabin John, Md. (R. C. Shannon).

The queens of this species seem to disappear early in the year, though there should be some out in the fall. The workers are very abundant from early July to late September. In October the males are practically the only representatives of the Bremidae to be found. October 24, 1915, at Chain Bridge, Va., I saw fully two dozen flying around a small group of asters.

I have the following specific flower records, although this species feeds on almost every flower.

Pontederia cordata *Chrysopsis mariana*
Xolisma ligustrina

4. **Bremus perplexus** (Cresson).

No representatives of this species have been recorded from this locality, but on the chance that it might be picked up, it has been included in the keys. It has been taken to the south (Pennington Gap, Va.), although it is a northern form. If found it will probably be in the higher parts near Great Falls, Va.

5. **Bremus vagans** (F. Smith).

A common species from May to October.

Queens	April 28, on and near Plummer Id., Md.
	July 12 at Plummer Id., Md.
?	Oct. 30, at Cabin John, Md. (R. C. Shannon).
Worker	June 9, at Beltsville, Md.
	Oct. 31, at Great Falls, Va. (R. A. Emmons).
Male	July 7, at Virginia, near Plummer Id., Md.
	Oct. 11, at Spring Hill, Va.

The queens were abundant on April 28, and close collecting a trifle earlier would probably have shown them present. The questionable record is either a small queen or large worker, probably the latter. The worker from Great Falls is the latest date I have taken bumblebees in this region.

Flowers record are:

Pontederia cordata	*Monarda fistulosa*
Brassica juncea	*Pentstemon hirsuta*
Mertensia virginica	*Arctium minus*

6. **Bremus fervidus** (Fabricius).

A rather uncommon species here.

Queens	April 28, at Virginia, near Plummer Id., Md.
	May 19, at Great Falls, Va. (W. L. McAtee).
Worker	June 14, at Rives, Md.
	Aug. 29, at Woodridge, D. C.
Male	Sept. 23, at Hunting Creek, Va. (W. L. McAtee).
	Oct. 12, at Plummer Id., Md. (A. K. Fisher).

I have only two flower records for this species *Mertensia virginica* and *Koellia flexuosa*.

7. **Bremus pennsylvanicus** (De Geer).

A common species all summer.

Queens	April 22, at Mt. Vernon, Va. (W. L. McAtee).
	June 19, at Bladensburg, Md.
Worker	April 28, on Maryland shore near Plummer Id.
	June 14, at Rives, Md.
	Oct. 15, at Dyke, Va. (G. P. Van Eseltine).
Male	July 27, on Maryland shore near Plummer Id.
	Oct. 17, at Falls Church, Va. (J. Silver).

The April 28th worker may be a small queen, but it is not impossible that it is a worker. I have heard of a record for this species of March 10 for the queen, but have not been able to verify it. If true, April 28th is not too early for workers to appear.

I have the following flower records:

Prunus sp.	*Chrysopsis mariana*
Gentiana andrewsi	*Cirsium lanceolatum*
Mertensia virginica	

The gentian record is interesting as in order to get at the nectar the bee had to pry open the end of the flower and once in, back out. G. P. Van Eseltine, who collected the specimen, says it had worked on several blossoms before he took it, and had simply parted the corolla at the tip.

8. **Bremus auricomus** (Robertson).

This and the following species belong to the subgenus Bombias and are none of them common in this region.

Queens	April 6, at Plummer Id., Md. (W. L. McAtee).
	Sept. 10, on Maryland shore near Plummer Id.
Worker	July 24, at Four Mile Run, Va.

Male	July 14, at Lakeland, Md. (W. L. McAtee).

I have only one record each for worker and male.

9. **Bremus fraternus** (F Smith).

One worker from Colonial Beach, Va., is the only specimen of this species I have seen from near here. Mr. J. C. Crawford, formerly of U. S. National Museum, has taken one specimen of this species near Bethesda, Md. If it breeds here regularly it is extremely local in distribution.

10. **Bremus separatus** (Cresson).

About as common as *auricomus*.

Queens	May 7, at Plummer Id., Md.
	Sept. 16, near Glen Echo, Md.
Worker	June 8, at Cherry Hill, Va. (J. Silver).
	July 25, at Rosslyn, Va. (W. L. McAtee).
Male	July 25, at Great Falls, Va. (W. L. McAtee).
	Aug. 1, at Mt. Vernon, Va.

Psithyrus laboriosus (Fabricius).

Only one species of this genus occurs here. The female may be told by always having first two dorsal abdominal segments black, usually the entire abdomen is covered with black pile. The male has a rougher, more unkempt appearance than any male of *Bremus* found here, though *perplexus* males approach it.

Females occur from May 17 to August 29, and the one male I have from this locality was taken July 28.

SOME NOTES ON THE GENUS TRACHYKELE WITH A DESCRIPTION OF A NEW SPECIES (BUPRESTIDAE, COLEOPTERA).

By H. E. Burke, *Bureau of Entomology.*

Seventeen years ago Mr. E. A. Schwarz showed the writer the single specimen of Trachykele then in the United States National Museum and said: "Do not bring in the common things. Get the rare ones. Get the rare ones." Since that time over a hundred specimens of the four named species have passed through the hands of the writer and the Museum now has the most representative collection of Trachykele in the world. All from the deep impression made on the mind of a young collector by the inspiring words of Mr Schwarz.

In April, 1919, Mr. R. D. Hartman, of the Los Gatos Forest Insect Laboratory, collected at Mt. St. Helena, Lake County, Calif., in the Sargent cypress (*Cupressus sargentii*) an adult of an apparently very distinct species. Larvae and infested wood were collected at the same time and on May 26 and May 29, respectively, two more adults of the same form emerged.

The four named species of the genus fall into two groups: one with the beetles green and the impressed area on the dorsal plate of the prothorax of the larva broad, and the other with the beetles bronze and the impressed area on the dorsal plate of the larva narrow. The new species has the beetle bronze but otherwise more like the green species. Its general appearance is similar and the larva has the impressed area of the dorsal plate broad. Is it a sport of one of the present named species or is it a local surviving species of the genus which at one time may have contained a number of flourishing species?

Taking the evidence as a whole, the writer is inclined to believe that Trachykele is a vanishing genus. Many beetles of all of the species through some weakness fail to emerge from the wood. Sometimes fragments of many dead specimens are found in an old scar on one tree. This condition may explain the rarity of specimens in most collections. At least, it indicates to the writer that the species now existing are not very well fitted to present conditions and probably are slowly vanishing.

The new species appears more closely related to *blondeli* Mars. than to any of the other species. It may be a sport of that species. *Blondeli* occurs in the same host within a hundred miles and at its closest point appears to vary considerably. Some specimens are entirely green while others have golden or coppery margins. In other localities all specimens are green.

Trachykele hartmani, n. sp.

Adult Holotype, Female.—Large, stout, length 22 mm., width 8 mm., coarse elongate oval, widest about distal third of elytra; brownish bronze, elytra with a violet tinge and golden reflections, marked by black velvety depressed areas some of which tend to form three fasciae on each elytron and some smaller ones which tend to form rows along the suture; entire body beneath clothed with coarse whitish recumbent hairs and marked by large pits to and including the first abdominal sternum and by smaller pits beyond. *Head* marked by a short frontal ridge and clothed ventrally by the whitish hairs, eyes elongate oval and brownish; antennae reaching nearly to the caudal margin of the thorax, joints 1–4 rather round and long, 1st longest, joints 5–11 more flattened and triangular. *Prothorax*, length 5 mm., width 7 mm., slightly wider at base than at apex, sides strongly angulate, caused by well developed lateral crests; disk with three anterior impressions and two large posterior ones, median anterior impression raised, terminating posteriorly in a smooth ridge which ends in a small pit close to the posterior margin, surface marked by large pits and some white hairs. *Elytra* slightly wider and three times as long as the prothorax, humeri rather prominent; sides slightly diverging for two-thirds of length, thence gradually narrowed; apex subtruncate; disk rough, with numerous longitudinal and transverse ridges, surface pitted, without prominent hairs. Tibiae nearly straight, fifth ventral rounding.

Allotype, Male.—Length 16 mm., width $6^1/_2$ mm., sides of elytra nearly parallel for two-thirds of length, thence gradually narrowed; fifth ventral truncate.

Larva.—Thorax broad, flattened, sub-quadrate, three segmented; abdomen slender, sub-cylindric, ten-segmented; texture smooth, shining; translucent whitish; pubescence sparse. *Head*, mostly retracted into prothorax, medium sub-orbicular, not strongly chitinized, mouth parts darker; front well developed, pits prominent, anterior frontal margin sinuate, anterior epistomal margin arcuate; clypeus sub-quadrangular, broader than long; labrum sub-cuniform, broader than long; antennae apparently three-jointed, basal joint large, 2nd long, cylindric distal margin fringed, 3rd very small, telescoped into the tip of the 2nd, bearing a long, lateral sub-distal bristle; mandibles broad, well developed, blackish, distinctly three-toothed; genae well developed, sub-quadrate, central margins darked anteriorly; gula narrow, darker anteriorly; mentum and sub-mentum fused, triangular; labium longer than broad, anterior margin rounding, palpi sometimes faintly indicated; maxillae prominent, light colored, cardines large, irregular, much broader at base, stipes slightly clavate, shorter than cardo and darker, palpi about same length as stipes, two-jointed, 1st long and cylindrical, 2nd short and conical, lacinae about same length as first joint of palpus, flattened, declivent, inner margin setoes. *Prothorax* large, cordate; plates well developed, dull, rugulose; dorsal marked by an inverted Y of median grooves which has a large broad, diamond-shaped, reticulated depressed area surrounding its base, grooves and depressed area outlined by slightly larger rugosities; ventral marked by a broad median groove which has its anterior end surrounded by a broad reticulated depressed area, the whole forming a torch-like marking, and two small depressed areas, one on each side of the median groove about one-third of the distance from the posterior margin. *Mesothorax* narrower than prothorax, very short, bearing a large spiracle on each side near the anterior margin. *Metathorax* slightly broader than mesothorax and about twice as long. *First abdominal segment* united to metathorax, broadest anteriorly, shorter than following segments, without distinct lateral folds, spiracle on each side near anterior margin; *segments 2–8* subcylindric, with distinct lateral folds, spiracle on each side dorsad of lateral fold, $^1/_4$ distance from anterior margin; *9th* slightly narrower and shorter than preceding, broadest anteriorly, with trace of lateral fold; *10th* small, conical, divided posteriorly into two short, fleshy lobes.

Habitat.—Mt. St. Helena, Lake County, Calif. Described from two females, one male and a number of larvae collected by Mr. R. D. Hartman from the wood of the Sargent cypress (*Cupressus sargentii* Jepson).

Type, Allotype and *Type Larvae.*—Cat. No. 22804, U. S. Nat. Mus.

A PECULIARLY MARKED ADULT OF NEZARA VIRIDULA L. (HEMIP.).

By Thos. H. Jones, *U. S. Bureau of Entomology.*

While making a collection of adults of the southern green plant-bug (*Nezara viridula* L.) at Baton Rouge, La., August 26, 1919, Mr. C. F. LaGrone took two abnormal individuals. Mr. LaGrone has called my attention to these individuals and, especially since one shows such a marked difference in coloration from the typical green specimens of the species, I have thought it advisable to present the following note concerning them.

Both individuals are females and were collected on beans. One, while generally of the normal green color, has light areas, so outlined as to give bilateral symmetry of markings, on the dorsal surface of the head, upon the pronotum, and upon the hemelytra. These are indicated in Fig. 1. When the adult was alive these areas were white but in the mounted specimens took on a yellowish tinge.

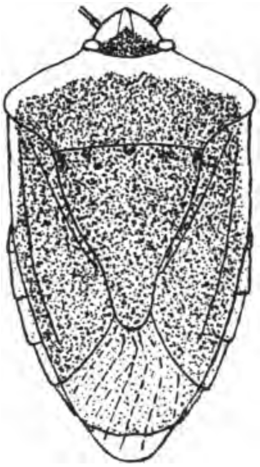

Fig. 1—Nezara viridula.

A light colored area covers about one-half of the dorsal surface of the head and includes all that portion anterior to a V-shaped line whose ends are opposite the middle of the inner margins of the compound eyes, and whose middle is on the tylus somewhat anterior to the beginning of the sutures between it and the juga. Another light colored area occurs on the anterior portion of the pronotum, nearly one-half of which it covers. It includes all of the pronotum anterior to a wavy line whose ends originate just back of the lateral angles and which is slightly curved forward. On each hemelytron there is a light colored longitudinal band on the embolium. This is more pronounced near the base of the embolium and extends only about half the distance from the base to the membrane. The lateral margins of the ventral surface of the head and thorax are light in color and the connexivum is lighter than in normal green specimens.

The other individual referred to has a malformed scutellum, the apex being abnormally small and distorted so that it ends in a sharp tip which is directed upward at an angle of about 45° from the dorsal surface of the body.

Both specimens have been placed in the United States National Museum.

NEW SPECIES OF NEOTROPICAL PYRAUSTINAE (LEPID.).

By W. Schaus.

In accordance with my practice, only one specimen is considered as type and although there are often more specimens before me, I have not included them in the type series, basing the description on one specimen only.

Neurophyseta durgalis, new species.

Female.—Body white, the abdomen with a dorsal brown spot near base, and broad segmental lines on terminal half. Wings white; a marginal brown line interrupted by veins. Fore wings: an antemedial, almost medial fine yellow line, outangled on costa, incurved across cell, then vertical to inner margin; an incurved double black line on discocellular meeting in front; postmedial space to line irrorated with light brown, which extends to termen between veins 2 and 5; veins from cell brownish ochreous; postmedial line black, finely wavy and vertical to vein 4, then incurved to vein 3, below which it is obsolescent, preceded by a white spot between veins 5 and 6, and by fuscous shading between veins 5 and 3, followed closely by a brownish line which continues to inner margin. Hind wings: a postmedial dark brown line, fine from costa to vein 2, then broad to inner margin, followed by a yellowish parallel shade. Wings below with the markings less distinct.

Expanse, 15 mm.

Habitat.—Volcan de Santa Maria, Guatemala.
Type.—Cat. No. 23519, U. S. N. M.

Neurophyseta tanamoalis, new species.

Male.—Palpi white. Body above pale ochreous gray, the abdomen dorsally slightly darker, legs white. Fore wings pale ochreous gray, the lines and cilia white; a medial line outangled to discocellular in front, inbent across cell and vertical to inner margin; postmedial line evenly outcurved from costa to vein 2, then slightly outcurved to inner margin. Hind wings white, the terminal half faintly suffused with ochreous gray; a dark point on termen before anal angle. Fore wings below with only the postmedial line.

Expanse, 12 mm.

Habitat.—Tanamo, Cuba.

Type.—Cat. No. 23520, U. S. N. M.

Neurophyseta volcanalis, new species.

Male.—Palpi, head, and thorax white. Abdomen above pale ochreous, underneath white. Fore wings with the apex produced, the termen slightly excised below it. Wings white, the lines fine, brown. Fore wings: a curved basal line; a yellowish antemedial outcurved shade; a medial line, outangled on median; discocellular defined by a straight line proximally, by an incurved line distally; a yellow streak on costa above discocellular, and a streak below vein 8 postmedially; postmedial line curved from costa to vein 4, inbent to vein 2, and again inbent parallel with medial line to inner margin, followed by a yellowish shade, broad on costa, very indistinct below vein 4; a minutely wavy marginal line followed by a yellow shade on termen. Hind wings: curved basal and antemedial lines; a double line at discocellular, the outer one extending towards costa; a postmedial line outcurved beyond cell, incurved at vein 2, followed by a yellowish shade; a marginal line followed by a yellowish shade at apex. All the lines minutely wavy. Wings below white, the lines less distinct.

Expanse, 12 mm.

Habitat.—Slopes of Popocatepetl, Mexico, between 8,000 and 10,000 feet.

Type.—Cat. No. 23521, U. S. N. M.

Neurophyseta albimarginalis, new species.

Female.—Palpi white, finely streaked above with fuscous. Head, collar, and thorax white; a small pale ochreous shade on center of patagia. Abdomen above black with fine white segmental lines; anal segment white. Body below and legs white; fore tarsi with brown rings. Fore wings: base, costal, and outer margins white; a vertical antemedial line brown on costa, otherwise black, slightly outcurved below cell, preceded below cell and on inner margin by a gray shade; postmedial line remote, outcurved and inbent to antemedial line on inner margin, followed by a gray shade from vein 4 to inner margin;

the space between the two lines brownish purple except the white costa; a white shade on discocellular; a white streak on submedian. Hind wings brownish purple; the base and inner margin narrowly white, the costal and outer margins broadly white; a curved antemedial black line; a black postmedial line only slightly curved followed by a broad dark shade to inner margin; the white on inner margin expanding between the two lines. Wings below white, the dark spaces of upper side showing as a grayish shade.

Expanse, 20 mm.

Habitat.—Volcan de Santa Maria, Guatemala.
Type.—Cat. No. 23522, U. S. N. M.

Psephis gomalis, new species.

Male.—Palpi white, the second and third joints ringed with pale brown. Head, collar, and thorax silvery gray. Abdomen above light brown with silvery segmental lines. Body below and legs whitish, the tarsi with brown rings. Wings silvery gray with darker gray irrorations below cells and on outer margins; a terminal brown line. Fore wings: a slightly outbent antemedial brown line; a slight outcurved postmedial brown line; a fine dark streak on discocellular. Hind wings: a postmedial brown line to anal angle. Wings below more silvery; the lines as above but without the antemedial line on fore wing.

Expanse, 12 mm.

Habitat.—Volcan de Santa Maria, Guatemala.
Type.—Cat. No. 23523, U. S. N. M.

Homophysa pomonalis, new species.

Female.—Palpi, head, collar and thorax yellow; some white mottling on head. Abdomen above brown with white segmental lines; the basal segment white, the anal segment yellow. Fore wings: basal third and costal margin yellow suffused with orange below cell to inner margin and on outer half of costa; medial and postmedial space lilacine thickly irrorated with fuscous, its outer edge outcurved beyond cell, incurved along vein 2, outangled on submedian, crossed at its outer edge by the postmedial line from vein 6 to below vein 2, this line being double, divided by a pale lilacine shade and is proximally and distally shaded with orange brown, more broadly so between vein 2 and inner margin; apex and termen yellow with darker shading along veins. Hind wings white, the termen shaded with yellow, deeper colored at vein 2 where it is preceded by a small fuscous spot.

Expanse, 14 mm.

Habitat.—Cayuga, Guatemala; French Guiana; Cuba.
Type.—Cat. No. 23518, U. S. N. M.
Near *H. fulminalis* Lederer.

Lipocosma alegralis, new species.

Male.—Palpi: the second joint brown ringed with black at either end, the third joint white. Head brown with white tufts on vertex. Collar brown tipped with white. Thorax brown with white lines on patagia. Abdomen above reddish yellow. Body below and legs silvery white; dark spots at base of fore tarsi. Fore wings yellow brown, paler on costa, darker towards termen; a dark brown spot at base of costa, and some brown irrorations at base of inner margin; an antemedial broad white line from median, inbent to inner margin, followed by a short horizontal line below cell; a black line on discocellular preceded by a broad hyaline lunule; a broad fuscous line from vein 7 before termen inbent to vein 2; a black spot on costa before apex with white on either side; a black line from vein 7 terminally to tips of cilia on apex; a terminal white line from vein 7 to vein 4, the cilia white with a brown line at base; a fuscous teminal line from vein 4 to near vein 2, followed by fuscous cilia; cilia at tornus white. Hind wings white; a black spot on discocellular; apex and termen broadly fuscous brown, narrowing somewhat to vein 3, inwardly edged by a dark postmedial line which continues to vein 2, and is marked by a fuscous spot between veins 5 and 6; a terminal white line from costa to vein 3 inwardly edged by a fine black line, and outwardly by a brown line on base of cilia which are white mottled with brown; below vein 3 to anal angle the cilia are white; a small black terminal point below vein 2. Fore wings below darker brown shading to yellowish on costa; the markings as above. Hind wings below the same as above.

Expanse, 17 mm.

Habitat.—Cayenne, French Guiana; Panama; Guatemala.
Type.—Cat. No. 23565, U. S. N. M.

Lipocosma chiralis, new species.

Male.—Palpi, head, collar, thorax, basal and anal segment of abdomen, also anal tufts white; abdomen otherwise above dark ochreous; abdomen below pale ochreous; legs white streaked with ochreous, the tarsi with ochreous spots. Fore wings: the base white to middle of costa and to one-third of inner margin limited by a golden brown shade outangled on costa, then incurved to inner margin; a dark brown streak on discocellular; postmedial space white crossed by a vertical, rather broad, dull brown shade from vein 5 to inner margin; a subapical golden brown line outcurved from costa to vein 4; apex and termen from vein 5 to inner margin silvery white; terminal black points. Hind wings silvery white; a black spot on inner margin just beyond middle; a postmedial sinuous brown line from vein 2 to inner margin; a terminal brown shade at anal angle, edged above with some black irrorations; terminal black points; cilia silvery white. Wings below silvery white; fore wings streaked with black on base of costa, then with ochreous brown to apex; a subapical curved brown line; two black points on discocellular.

Expanse, 12 mm.

Habitat.—Santiago, Cuba.

Type.—Cat. No. 23524, U. S. N. M.

Near *L. nigripictalis* Hampson.

Lipocosma savoralis, new species.

Female.—Body and fore wings light brown tinged with iridescent lilacine; an antemedial fuscous brown line slightly outcurved, a similar postmedial line deeply outcurved from costa to vein 3, then inbent to inner margin; cilia fuscous brown. Hind wings thinly scaled, pale brownish ochre, the termen darker; an interrupted terminal dark line, except at anal angle and at apex. Wings underneath silky brownish ochre.

Expanse, 17 mm.

Habitat.—Baracoa, Cuba.

Type.—Cat. No. 23525, U. S. N. M.

Symphysa glorialis, new species.

Female.—Palpi white. Frons brown. Vertex and body white. Fore wings creamy white; a silver streak below subcostal from near base to beyond cell; an inbent yellow ochre line from cell antemedially to inner margin near base, and a similar more vertical line from across end of cell to middle of inner margin; an incurved silver line on discocellular extending slightly on vein 4, and interrrupted at its middle; a fine subterminal black line, outcurved below costa, forming two incurved lunules across veins 3 and 2, then outcurved to submedian; termen shaded with pale yellow, with silver streaks on interspaces; a silver line on base of the white cilia. Hind wings white; a medial yellow shade below cell; dark postmedial points on veins 2–4; small marginal dark spots; two marginal opalescent spots edged with silver below vein 2; the anal angle white; cilia as on fore wing. Fore wings below white; dark marginal points between vein 4 and apex; a subapical dark line. Hind wings below white; silvery spots with black points below vein 2 on termen.

Expanse, 14 mm.

Habitat.—Cayenne, French Guiana.

Type.—Cat. No. 23564, U. S. N. M.

Symphysa hermalis, new species.

Female.—Palpi and head white shaded with ochreous. Collar and thorax ochreous brown. Abdomen above fuscous brown with very fine white segmental lines. Fore wings thickly suffused with brown scaling to postmedial line, which is very fine, whitish, outcurved below costa and parallel with termen, almost imperceptible; terminal space less thickly irrorated with brown; terminal black spots on veins preceded by a silvery shade. Hind wings: costal half whitish, the anal half brown irrorated with black; traces of a postmedial and a subterminal whitish line, both very indistinct; terminal black spots; cilia long, brown at base, tips silvery gray. Fore wings below brown, the inner margin broadly silvery gray; the postmedial white line more distinct, an interrupted terminal black line. Hind wings below silvery gray, the costa and medial space to vein 2 suffused with brown; a black point on discocellular; a sinuous postmedial black line not reaching inner margin and outwardly edged with white; outer margin thinly irrorated with brown; a terminal black line interrupted by veins.

Expanse, 13 mm.

Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 23527, U. S. N. M.

Symphysa maralis, new species.

Female.—Palpi, head, and abdomen above light brown; abdomen below white; legs light brown, the tarsi white with fine brown rings. Fore wings light brown, darker shaded on terminal third with faint traces of a subterminal sinuous fuscous line. Hind wings whitish at base and on costa, otherwise suffused with light brown, leaving a wavy medial and a subterminal line white. Fore wings below tinged with whitish brown, the cilia fuscous brown. Hind wings below white, the terminal space faintly tinged with brown leaving the subterminal line white; cilia brown.

Expanse, 18 mm.

Habitat.—Matanzas, Cuba.
Type.—Cat. No. 23563, U. S. N. M.

Symphysa matanzalis, new species.

Female.—Head, collar, and thorax mottled brown and white. Abdomen grayish brown. Fore wings: basal half dark brown limited by a vertical white line; medial space whitish gray irrorated with brown limited by the postmedial line, which is white, vertical on costa, then outcurved to vein 2 and vertical to inner margin; marginal space dark brown; a terminal black line preceded by minute lilacine white spots. Hind wings white, the outer margin dark brown except from vein 2 to anal angle, where there is only some brown subterminal scaling; some brown scales on inner margin close above angle, a terminal black line; cilia on both wings brown. Fore wings below silvery white, the cell, costal and outer margins suffused with brown. Hind wings below white; the costal margin, apex broadly and outer margin to vein 2 suffused with brown; a brown spot on discocellular; a terminal black line on both wings.

Expanse, 13 mm.

Habitat.—Matanzas, Cuba.
Type.—Cat. No. 23526, U. S. N. M.

Scybalista chicalis, new species.

Male.—Palpi, head, collar and thorax white, irrorated and suffused with brown. Abdomen above brown with white segmental lines. Fore wings semihyaline, the veins white except vein 6 which is dark brown; fuscous streaks at base on costa, below cell, above and below submedian; inner margin tinged with light brown; a subterminal white line, gently curved from costa to vein 3, then inbent to inner margin below discocellular, preceded by dark brown irrorations on interspaces from costa to vein 3 and with very fine dark streaks close to veins 11–7 and above vein 5; outer margin light brown on interspaces; a terminal white line; two triangular black spots on discocellular, their apices almost touching. Hind wings semihyaline white, the veins yellowish; dark terminal points on interspaces. Wings below silvery white.

Expanse, 15 mm.

Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 23528, U. S. N. M.

Pycnarmon breiralis, new species.

Male.—Palpi white, the second joint laterally streaked with gray towards third joint; the third joint gray. Head and body fuscous gray; abdomen above with white segmental lines, underneath whitish gray; legs streaked with gray, the tarsi gray with white rings. Fore wings dark olive gray or silvery brown according to the light; a whitish line across costal margin postmedially. Hind wings silky brown. Wings below paler, with the line across costal margin of fore wing as above.

Expanse, 11 mm.

Habitat.—Venadio, Sinaloa, Mexico.
Type.—Cat. No. 23566, U. S. N. M.

Sufetula grumalis, new species.

Female.—Palpi gray with lateral black patches. Head, collar, and thorax gray. Abdomen above brown, underneath whitish gray. Fore wings gray; costal margin with black spots; an outcurved antemedial line, almost medial, somewhat interrupted; a black spot on discocellular; a postmedial, almost subterminal white line edged on either side with black, vertical from costa to vein 5, slightly inbent and vertical from vein 3 to submedian, inbent below it; an interrupted terminal black line. Hind wings gray; a black spot on discocellular; a postmedial line as on fore wing, vertical from costa to vein 2, then inbent to anal angle; a wavy marginal black line. Wings below grayish; black spots on discocellular; the postmedial line fainter; the marginal line as above.

Expanse, 15 mm.

Habitat.—Santiago, Cuba.
Type.—Cat. No. 23567, U. S. N. M.

Eurrhyparodes voralis, new species.

Male.—Palpi dark brown. Head, collar, and thorax lilacine irrorated with dark brown; a white line across frons above, and a broad white line across thorax, not extending on patagia. Abdomen above brown with some white at base, underneath white on basal half. Wings hyaline opalescent. Fore wings: costa ochreous with numerous transverse streaks and spots, the latter on terminal third; a broad streak below costa; apex, outer margin, basal half of cell, a somewhat shorter space below cell and outer half of inner margin lilacine brown with darker brown irrorations; basal half of inner margin except immediate base white with two dark spots descending from submedian; a large spot on discocellular suffusing above with the costal streak; the inner edge of terminal brown space darker edged outcurved below veins 5 and 4, downcurved below vein 3 and upcurved along vein 2 but not touching the discal spot, again outcurved below vein 2, and incurved on submedian; a series of subterminal white lunules from vein 8 to vein 3; cilia white tinged with yellow at base, divided by dark streaks at veins 3 and 4, and at apex. Hind wings: a small dark brown spot on discocellular; small light brown marks postmedially on veins from vein 2 to inner margin; apex brown diminishing to vein 3, inwardly edged by a wavy white line, and with some white terminal mottling widest at apex; dark terminal points from vein 2 to anal angle. Underneath duller.

Expanse, 22 mm.

Habitat.—Sao Paulo, Brazil.
Type.—Cat. No. 23562, U. S. N. M.
Near *E. syllepidia*, Hampson.

Desmia julialis, new species.

Male.—Antennae with a small tuft of hairs above near middle. Palpi black, at base ochreous. Throat white. Head and thorax fuscous brown. Abdomen black with segmental white lines above; underneath white with the anal segments and two broad transverse bands black; the anal hairs white. Wings fuscous brown with a cupreous tinge; cilia black with a fine whitish line at base, and narrow whitish tips; the cilia on forewings with a white spot close to tornus. Fore wings with a white hyaline spot across cell, narrowest on subcostal, to submedian, slightly outbent, and outangled below cell; a narrow spot beyond cell from vein 8 to just below vein 3, ending in a point. Hind wings: the costa whitish to near apex; an antemedial white line across cell; a broad medial line narrowing to a point below middle of inner margin; a postmedial downbent line from vein 6 to vein 3, and a white streak between veins 6 and 7 not reaching termen. Wings below duller, the costa of hind wings fuscous brown.

Expanse, 22 mm.

Habitat.—Avangarez, Costa Rica.
Type.—Cat. No. 23529, U. S. N. M.

Desmia minnalis, new species.

Male.—Antennae excised and with a small tuft of hairs at middle. Palpi brown, at base white. Body brown, the abdomen above with fine segmental white lines; underneath white with brown bands on alternate segments; anal segments silvery with brown shading. Wings dark brown shaded with purple and cupreous, the spots and lines opalescent white; cilia with a fine white line at base and white tips. Fore wings: a nearly round spot in cell adjoining a spot below cell which becomes narrower at submedian, edged with fuscous which extends to inner margin; a narrow spot beyond cell from vein 8 to just below vein 5, edged with fuscous. Hind wings: costal margin grayish white to near termen, and a similar streak between veins 6 and 7; the termen incurved at vein 5; a fine antemedial white streak across cell; a medial white line fairly broad, tapering to a point on inner margin above angle, inwardly broadly shaded with fuscous, and followed by a fuscous spot from below vein 6, to vein 3.

Expanse, 28 mm.

Habitat.—Aroa, Venezuela.
Type.—Cat. No. 23530, U. S. N. M.

Desmia natalialis, new species.

Male.—Antennae excised above and preceded by a small tuft of hairs before middle. Palpi fuscous brown, at base white. Throat white. Head, collar, and thorax fuscous brown. Abdomen above brown on two basal segments, otherwise black with white segmental lines; paired white streaks on anal segment; underneath white. Legs fuscous brown in front, the tarsi pale ochreous. Wings dark brown with a supreous tinge, the lines and spots white. Fore wings: a narrow white line across cell and a small triangular spot below cell, slightly outset; a slightly broader line beyond cell from vein 8, its outer edge indentate on vein 7, outcurved between 7 and 6, narrower between veins 6 and 5; cilia fuscous brown with a white spot above tornus. Hind wings: a very faint antemedial whitish spot in cell; a narrow line from below vein 6 broadly shaded with fuscous on either side, to vein 4, inset at vein 3, inwardly shaded with fuscous, vertical to inner margin close to angle; termen deeply incurved at vein 5; cilia brown with a pale line at base, and tipped with white except at anal angle. Hind wings below tinged with gray.

Expanse, 24 mm.

Habitat.—Volcan de Santa Maria, Guatemala.
Type.—Cat. No. 23531, U. S. N. M.

Desmia benealis, new species.

Male.—Antennae excised above at middle preceded by a short tuft of hairs. Palpi dark brown, at base white. Body above dark brown; abdomen with white segmental lines; a double white streak on last segment, not reaching end; anal hairs ochreous; underneath white with segmental brown lines. Legs brown, the tarsi white with brown spots. Wings fuscous brown with a cupreous tinge, the markings white. Fore wings: an antemedial white spot in cell; a medial broad line from costal margin, expanding outwardly in a curve across cell, constricted on medial vein, then expanding somewhat, terminating at submedian, edged throughout with fuscous and followed between vein 2 and submedian by a fine white line; a faint whitish streak on discocellular with fuscous edging; a spot edged with fuscous beyond cell, from vein 8 to vein 3 surmounted on costa by an ochreous streak, its inner edge lunular, its outer edge inangled at vein 7, outangled below 7, and inbent to vein 3, followed from costa to vein 5 by a fine ochreous white line; terminal ochreous points at veins; cilia brown with a pale and a black line at base, and a white spot above tornus. Hind wings: an antemedial small quadrate spot in cell, and a wavy outset line from below cell to near middle of inner margin; a medial line, broad at vein 6, projecting outwardly at vein 5, below vein 5 inset, and narrow to near anal angle; a fine postmedial line from vein 6 to vein 4; cilia fuscous with a pale and black line at base; cilia tipped with white from below vein 2 to near anal angle.

Expanse, 21 mm.

Habitat.—Volcan de Santa Maria, Guatemala.
Type.—Cat. No. 23532, U. S. N. M.

Desmia Jonesalis, new species.

Female.—Palpi fuscous, at base white. Body black tinged with brown. Wings dull fuscous brown, the markings white. Fore wings: a small medial spot in cell; a broad incurved spot beyond cell from vein 8 to vein 3; cilia from vein 4 to tornus shortly tipped with white. Hind wings: an antemedial white spot from just within cell, where it is pointed, to near middle of inner margin; its proximal edge slightly incurved; a large spot beyond cell from vein 6 to vein 3; cilia tipped with white near anal angle. Fore wings below similar; the inner margin whitish; a very small white spot below vein 2.

Expanse, 20 mm.

Habitat.—Sao Paulo, Brazil.
Type.—Cat. No. 23533, U. S. N. M.

Desmia angustalis, new species.

Male.—Antennae simple. Palpi fuscous brown fringed with white at base and tips. Frons dark brown with lateral white lines. Vertex black. Collar and patagia fuscous shot with blue; thorax fuscous brown. Abdomen above fuscous shot with blue; a broad, transverse, white line at base and a finer line on fourth segment. Abdomen below brown with a white segmental line on fourth segment. Legs brown with white spots at segments of tarsi; fore and hind femora silvery. Wings very narrow, fuscous brown, slightly cupreous, the markings semihyaline opalescent. Fore wings: an outbent spot from subcostal to submedian; a narrow spot inbent from costa to just below vein 4, narrowest between veins 7 and 8; a faint whitish line on discocellular. Hind wings: an antemedial fascia from within cell to inner margin; a spot beyond cell from vein 4 to vein 6, slightly pointed anteriorly.

Expanse, 17 mm.

Habitat.—Volcan de Santa Maria, Guatemala.
Type.—Cat. No. 23534, U. S. N. M.

Desmia anitalis, new species.

Male.— Antennae minutely serrate with short cilia. Palpi brown, shortly fringed with white, broadly so at base. Head, collar, thorax and base of abdomen brown; lateral pale lines on frons and a whitish spot on vertex. Abdomen above terminally fuscous brown; traces of white segmental lines; a white spot on terminal segment; abdomen below white, the last three segments brown. Fore femora and tibiae dark brown; tarsi ochreous white. Wings dark cupreous brown, the markings white; cilia fuscous gray, a basal line and tips mostly white. Fore wings: a broad, white, medial line from costal margin to inner margin, slightly outcurved, followed from vein 2 to inner margin by a narrower white line; postmedial spot broadest on costa where it is ochreous, narrowing to a point at vein 4, its inner edge straight, its outer edge dentate between veins 7 and 6; incurved below it and rounded to vein 4. Hind wings: a medial line widest across cell, narrowing to a point on inner margin below middle, edged by a dark line on discocellular which is followed by a narrow white line from veins 6–4. Hind wings below shot with silvery gray.

Expanse, 24 mm.

Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 23535, U. S. N. M.

Desmia ilsalis, new species.

Male.—Antennae shortly ciliate. Palpi: the first and third joints ochreous white, the second joint fuscous brown. Head fuscous brown. Collar and thorax iridescent gray brown. Abdomen above purple brown, underneath ochreous. Fore wings cupreous purple brown, the spots opalescent; an antemedial white point in cell; a medial spot across cell expanding below cell but not reaching submedian; a large spot beyond cell, narrow between veins 8 and 7, expanding and widest between veins 5 and 4, not extending below vein 3; cilia tipped with white just above tornus. Hind wings semihyaline white, the base and margins broadly cupreous brown; cilia tipped with white near anal angle.

Expanse, 24 mm.

Habitat.—Peru.
Type.—Cat. No. 23536, U. S. N. M.

Desmia girtealis, new species.

Male.—Antennae shortly ciliate. Palpi fuscous brown, at base white; third joint white; head and thorax fuscous brown. Collar and patagia silky gray brown. Abdomen above purplish, underneath ochreous white; legs brown; tarsi ochreous white with broad, light brown rings. Wings cupreous brown, the spots opalescent white; cilia brown crossed by a black line, tipped with white at tornus of fore wing, and with white on hind wing except at anal angle. Fore wings: a quadrate spot across cell and a narrower adjoining spot below cell to submedian; the spot beyond cell larger, its inner edge incurved, from vein 8 to vein 3 where it ends in a point. Hind wings: a spot contiguous to discocellular from vein 6 to vein 5.

Expanse, 23 mm.

Habitat.—Peru.

Type.—Cat. No. 23537, U. S. N. M.

Desmia repandalis, new species.

Male.—Antennae minutely serrate. Palpi dark grayish brown fringed with white at base. Body above dark grayish brown; segmental white lines on abdomen; abdomen underneath white. Legs brown; tarsi mostly white. Wings fuscous brown tinged with purple; cilia with a fine pale line at base. Fore wings: spots white only faintly opalescent; medial spot oval from subcostal to submedian; postmedial spot from vein 8 to vein 3, expanding slightly between veins 5 and 4, becoming narrower below vein 4. Hind wings: a medial line widest on costa narrowing to a point above anal angle.

Expanse, 27 mm.

Habitat.—Chejel, Guatemala.

Type.—Cat. No. 23538, U. S. N. M.

This species appears abundant in Central and South America, and I have taken it in Cuba. There is considerable variation in the medial spot of fore wing, but the average specimen is like the type described. In general appearance it is like *Desmia Vulcanalis* Felder = *D. geminalis* Snellen but the simple antennae will differentiate the two species. The female, at present unknown, is possibly like the female of *Vulcanalis*, which is remarkably like the female of *Desmia tages* Cramer.

Lamprosema noctalis, new species.

Male.—Palpi dark grayish brown fringed with white. Head, collar, and thorax dull purplish brown. Abdomen brown with white segmental lines at end; anal hairs purplish brown. Body below silvery white, the legs grayish, the tarsi ochreous white. Fore wings reddish brown; antemedial line lilacine white, outwardly dark edged, vertical and sinuous; a transverse white streak across end of cell, slightly oblique, followed by fuscous lines on either side of discocellular, a white postmedial spot on costa from which the fine lilacine white line, with darker edging, is wavily outcurved to inner margin; a broad fuscous subterminal shade widest on inner margin; a fuscous terminal line; cilia fuscous tipped with white. Hind wings purplish brown with a projecting fold at base of inner margin with ochreous scaling and long fringe; postmedial line lilacine edged with black, somewhat incurved, preceded by a broad fuscous shade; a subterminal broad fuscous shade; a marginal lilacine line, followed by the broader black terminal line; cilia black tipped with white, and with a fine grayish line at base. Fore wings below pale ochreous, the white discal streak edged with black; a white postmedial spot on costa, and a macular fuscous postmedial line; subterminal fuscous irrorations on interspaces. Hind wings below lilacine white; faint traces of a dark postmedial line.

Expanse, 20 mm.

Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 23539, U. S. N. M.
Near *L. dorisalis* Walker.

Lamprosema cayugalis, new species.

Male.—Body above dark brown; palpi fringed with white; white transverse lines on abdomen near base, and near end; small white tufts behind antennae. Body below and tibiae whitish gray; tarsi pale ochreous. Wings dark brown. Fore wings: the lines fine, bluish white, broader and clearer white on costal margin; antemedial line vertical; an opalescent white spot across end of cell, broader behind than in front; edged on either side with fuscous; an oblique white spot below it, widest proximally and irrorated with brown; postmedial line outbent from costa to below vein 7, slightly rounded and inbent, wavy from vein 5 to inner margin; terminal space lighter brown, with a broad subterminal dark shade; a dark brown terminal line, inwardly edged by a fine white line; cilia narrowly tipped with white. Hind wings: the postmedial line faintly wavy to inner margin above anal angle. Wings below gray showing the white spots of fore wing.

Expanse, 24 mm.

Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 23540, U. S. N. M.
Near *L. pelealis* Walker.

Lamprosema santialis, new species.

Male.—Palpi dark brown, minutely fringed with white in front. Head, collar, and thorax lilacine brown. Abdomen brown with white lines near base and end, and with a white dorsal spot on last segment. Body below and legs white. Wings cinnamon brown, the lines fine, white; a marginal faint white line; cilia broadly white, with a dark line at base. Fore wings:

antemedial line slightly outbent, outwardly edged with dark brown; a narrow white streak across end of cell edged with dark brown; postmedial somewhat wider on costa darker edged, evenly outcurved beyond cell then straight to inner margin, followed by a lilacine gray shade from vein 8 to inner margin. Hind wings with the postmedial line straight to inner margin above anal angle, followed by a broad lilacine gray shade tinged with silver. Fore wings below grayish brown, showing the white cellular line and a curved finely dentate postmedial line; the inner margin whitish gray. Hind wings below whitish gray; a fine postmedial line dentate on veins 2–5.

Expanse, 20 mm.

Habitat.—Santiago, Cuba.

Type.—Cat. No. 23541, U. S. N. M.

Near *L. pelealis* Walker, but smaller with the spots reduced and the line more distinct.

Lamprosema moccalis, new species.

Male.—Palpi gray fringed with white. Body above and wings brown. White lines laterally on frons and vertex; throat white; white lines on abdomen near base and end; anal hairs tipped with white. Abdomen below and legs gray, the tarsi pale ochreous. Fore wings: a bluish white vertical antemedial line; a white spot across end of cell; edged with dark brown; postmedial line white and distinct on costa, then very fine, bluish gray, curved beyond cell and inbent to inner margin; a fuscous brown terminal line with the base of cilia similar and tipped with white. Hind wings: a very fine bluish gray postmedial line almost straight to inner margin above anal angle, followed by a faint grayish brown shade; a fine marginal whitish line; terminal line and cilia as on fore wing. Fore wings below dull brownish, the white spot as above. Hind wings below suffused with whitish gray.

Expanse, 28 mm.

Habitat.—Cayuga, Guatemala.

Type.—Cat. No. 23542, U. S. N. M.

Looks like *L. codrusalis* Walker, but the hind wing normal.

Lamprosema malticalis, new species.

Male.—Palpi dark gray fringed with white. Head, collar, and thorax purplish brown; lateral and central white lines on frons. Abdomen above brown on three basal segments with two transverse lines, then dull grayish brown with black segmental lines and a single white line; a dorsal white spot on last segment; anal hairs fuscous above, whitish underneath. Abdomen below light brown. Legs silvery white, the tarsi ochreous white. Wings dark brown. Fore wings: a fine whitish antemedial line outwardly darker edged, slightly outbent from costa; discocellular darker shaded; postmedial fine, whitish, very indistinct except on costa where it is outbent to near vein 6, and wavily inbent to inner margin; some fuscous irrorations near tornus; a terminal dark line, inwardly edged by a faint whitish line;

cilia brown with a fine whitish line at base, and tipped with white except from veins 3–5 where it is entirely brown. Hind wings: the inner margin ochreous brown; postmedial line fine, whitish, slightly sinuous, broadly followed by silvery irrorations; a marginal silvery line; a fine ochreous line at base of cilia which are dark brown with white tips, becoming fuscous at anal angle.

Expanse, 24 mm.

Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 23543, U. S. N. M.
Near *L. moccalis* Schaus.

Lamprosema brunnealis, new species.

Male.—Palpi grayish brown, white at base. Body above and wings uniform brown. Abdomen with fine white segmental lines shaded in front with fuscous. Body below silvery white; legs and fore femora grayish. Fore wings with the lines fine, whitish; antemedial from below costa, slightly outbent; a darker brown lumule at end of cell, preceded by an almost imperceptible fine white line; postmedial only slightly thicker on costa, outcurved, inbent below vein 4 and somewhat wavy; a terminal fuscous brown line; cilia brown with grayish tips. Hind wings with the postmedial line fine, almost straight and slightly inangled before inner margin, followed by a very faint grayish shade; terminal line and cilia as on fore wing. Wings below pale brownish gray without any markings.

Expanse, 23 mm.

Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 23544, U. S. N. M.
Near *L. malticalis* Schaus.

Lamprosema baracoalis, new species.

Male.— Palpi brown with a lateral white spot and fringe at base, the third joint ochreous. Head, collar, and thorax grayish brown, the frons with lateral ochreous lines, Abdomen above grayish brown, the last three segments with a single white line and dorsal white hairs on anal segment. Body below whitish, the throat silver white; legs pale grayish, the tarsi white. Wings light brown. Fore wings with an antemedial outcurved white line outwardly edged with fuscous; a transverse white spot in end of cell, edged with black, broader behind, its outer edge slightly inangled below subcostal and then outbent; a small white spot below vein 2; postmedial from a triangular white spot on costa, fine, white edged with black, curved and lunular from vein 7 to vein 4, almost obliterated by the black edging, then inbent to vein 2 and sinuous to inner margin; subterminal fuscous lunules on interspaces; a terminal fuscous line; cilia golden brown edged with black and tipped with white. Hind wings with a medial line straight from subcostal, slightly outset at vein 5, fine, white edged with black, and preceded by a narrow dark brown shade; postmedial and subterminal dark brown spots on interspaces; terminal line and cilia as on fore wing. Fore wings below pale ochreous brown, the inner margin whitish; spots as above; a postmedial series of dark points on veins; subterminal angled spots across veins; a fine terminal brown line. Hind wings below pale ochreous brown shaded with white; postmedial clusters of brown scales on interspaces; similar subterminal clusters on veins.

Expanse, 22 mm.

Habitat.—Baracoa, Cuba.
Type.—Cat. No. 23545, U. S. N. M.

Sylepta escuintlalis, new species.

Female.—Palpi fuscous brown. Head fuscous; a white shade on frons; a white spot on vertex. Collar, thorax, and abdomen above yellow; underneath white. Legs yellow streaked with brown; tarsi brown. Wings yellow with semihyaline streaks below cell and on interspaces between veins. Fore wings with the costa black from base to beyond middle.

Expanse, 39 mm.

Habitat.—Escuintla, Guatemala.
Type.—Cat. No. 23546, U. S. N. M.

Sylepta birdalis, new species.

Female.—Palpi grayish brown fringed with white at base. Head, collar, and thorax yellowish ochre shaded with purplish brown. Abdomen yellowish ochre at base, otherwise brownish. Wings thinly scaled, pale yellow. Fore wings: costal and inner margins to postmedial line ochreous yellow; a dark costal spot at base, and a subbasal dark point on inner margin; traces of an outbent antemedial smoky line from subcostal, followed in cell by a small double spot; a lilacine line on discocellular edged by fuscous lines; postmedial line fuscous, inbent from costa to vein 5, then outcurved and inbent to vein 2 where it is upbent towards discocellular angled and downbent to inner margin; terminal space beyond this line lilacine brown; cilia with a fuscous line at base. Hind wings: a smoky line on discocellular; postmedial line fine, outbent at vein 5 and forming three lunules to vein 2 where it is upbent, then angled and straight to inner margin; a lilacine brown shade at apex. Underneath similar.

Expanse, 31 mm.

Habitat.—Aroa, Venezuela.
Type.—Cat. No. 23547, U. S. N. M.
Near *S. pactolalis* Guenée.

Polygrammodes supremalis, new species.

Female.—Palpi brown above, white below. Head yellow brown. Collar and thorax fuscous brown shot with iridescent bluish steel color. Abdomen above yellow brown, the third segment dark reddish brown with subdorsal white points in front and a dorsal white point behind; anal segment pale yellow. Body below and legs white. Fore wings: base, except edge of costa and inner margin, broadly to the postmedial line, fuscous brown shot with iridescent steel; this dark space is edged in front by a fuscous brown line preceded by a dark yellow line and is oblique from costa to below end of cell just above submedian, then up and incurved to vein 2, angled and outbent to just above vein 2; the curve is followed by a black shade downbent to submedian; medially on inner margin an angled dark yellow line edged with fuscous brown; postmedial space pale brown; the medial space forming a large irregular triangle with its base on costa, pale yellow; a small spot in cell defined by some dark scales; a yellow streak on discocellular edged by a reddish brown line; the postmedial pale brown space does not extend above vein 8, the costa remaining yellow to apex, only crossed by the postmedial line which is outcurved, almost subterminal, fine, fuscous brown shaded on either side with yellow, thicker and geminate between veins 5 and 6, slightly outset and lunular from veins 5 to 2, vertical below vein 2, followed by an irregular, narrow grayish purple shade from veins 2 to 5, and above vein 5 to vein 7 by a similar diverging shade; termen pale yellow; a fine brown terminal line; cilia yellow. Hind wings: base and inner margin brownish purple; a fringe of long hairs below cell; medial space pale yellow forming a large irregular spot outwardly edged by the postmedial line, which is dark brown, thick, and vertical from costa to vein 5, then lunular to vein 2, slightly upcurved and outbent to inner margin where it is angled, followed by a purplish gray shade, widest from vein 4 to costa, and at anal angle; termen yellow. Wings below whitish showing the more thinly scaled medial blotches of upper side; fine postmedial fuscous streaks from veins 5 to 7, followed by subterminal grayish shades.

Expanse, 43 mm.

Habitat.—Castro, Parana, Brazil.
Type.—Cat. No. 23548, U. S. N. M.

Polygrammodes basaralis, new species.

Female.—Palpi purple fringed with white below; a reddish brown spot laterally at base. Head yellowish. Collar and thorax roseate purple. Abdomen above yellow. Body below and legs white; fore tibiae and tarsi streaked with purple. Fore wings: the basal half roseate purple extending on costal margin to the postmedial line; terminal half pale yellow; postmedial line purple, lunular, vertical to below vein 7, slightly inset and outcurved, lunular, to vein 2 where it is inbent and curved to vein 3; small dark spots adjoining cell between veins 3 and 5, small subterminal purple lunules on interspaces; almost imperceptible marginal points, more distinct towards apex; cilia yellow, the tips silvery, and with fuscous points at veins. Hind wings yellow, a large roseate purple spot at end of cell; an irregular postmedial fuscous line from vein 7, incurved to vein 5, lunular to vein 2 along which it is upbent and outbent towards inner margin before reaching cell;

short fuscous streaks below vein 3 and above veins 3 and 4 close to cell; subterminal dentate marks on interspaces and small marginal spots; cilia as on fore wing. Wings below whitish; the postmedial lines as above but fuscous; fore wings with a fuscous spot in cell, and a larger one on discocellular; subterminal spots and marginal spots only below costa; hind wings with the lines as above, but fuscous; subterminal and marginal spots between veins 6 and 7.

Expanse, 38 mm.

Habitat.—Sao Paulo, Brazil.

Type.—Cat. No. 23549, U. S. N. M.

Polygrammodes arpialis, new species.

Female.—Palpi black fringed with white at base. Body yellow above, white underneath; legs ochreous white, the tarsi with brown rings; abdomen above with dorsal transverse fuscous purple streaks posteriorly on segments, and subdorsal spots anteriorly on segments. Wings yellow, darkest terminally, on basal half of fore wings, and along inner margin of hind wings; markings fuscous purple; thick subterminal spots or lunules on interspaces; cilia white with black spots at veins. Fore wings: short basal streaks on costa and subcostal vein; a subbasal spot on costal margin; an inbent streak below cell, and a fine line on inner margin; an antemedial line slightly outbent from costa to median vein; an outset vertical streak from cell to submedian with an inbent streak below it; a medial spot in cell and a streak on discocellular; diverging postmedial streaks above and below vein 6; a small spot above vein 7; from veins 2–5 three longer streaks, their tips hooked anteriorly like the half of an arrow; a similar long streak below vein 2, with the hook on posterior side, down bent to submedian, followed by a short streak close to vein 2, and with an inbent streak on inner margin below it, this last followed by a streak along inner margin. Hind wings: a spot on discocellular and a smaller spot at origin of vein 2; postmedial streaks between veins 2–5 as on fore wing; diverging spots above and below vein 6; a spot below vein 2 with a wavy streak from it to inner margin. Wings below whitish, showing indistinctly the markings of upper side; cilia with black points; fore wings with a small black spot in cell and a black streak on discocellular.

Expanse, 53 mm.

Habitat.—Joinville, S. E. Brazil.

Type.—Cat. No. 23550, U. S. N. M.

This beautiful species is allied to *P. runicalis* Guenee, and was sent to me by my friend, Mr. Julius Arp.

Polygrammodes herminealis, new species.

Female.—Palpi black fringed below with white. Body white; abdomen above with transverse fine purple-brown lines. Wings white; marginal orange spots on interspaces; cilia white with dark gray spots at veins. Fore wings: a basal orange streak from costa to submedian, a subbasal black point on costa, and smaller dark brown points below median and on inner margin; an antemedial orange brown lunule in cell; a dark brown vertical streak below cell, more outset, and a point on inner margin; a medial dark brown vertical streak below subcostal, and a similar streak on discocellular; a medial vertical streak on inner margin; short streaks above and below vein 4 near cell; fine postmedial and subterminal vertical streaks on interspaces, closer together between veins 3 and 5, longer and inbent between veins 2 and 3, long and outcurved between vein 2 and submedian; a few dark brown streaks on inner margin postmedially. Hind wings: a few brown scales in end of cell; short streaks above and below vein 4; an outcurved fine postmedial line broadly interrupted by veins; subterminal line similar but more heavily marked and parallel with outer margin. Wings below white, the fore wings shaded on costa apically and on termen with pale brown; a fine dark line on discocellular.

Expanse, 32 mm.

Habitat.—Castro Parana, Brazil.
Type.—Cat. No. 23551, U. S. N. M.

Psara nigripes, new species.

Male.—Palpi: basal joint black with some white at base; second joint black with fringed white; third joint white tipped with black. Head, body, wings, and legs, orange; the tarsi black; the fore tibiae laterally fuscous.

Expanse, 28 mm.

Habitat.—Cayuga, Guatemala.
Type.—Cat. No. 23552, U. S. N. M.

Psara polypaetalis, new species.

Male.—Palpi yellow fringed with black, and some black scaling laterally at base. Frons brown with lateral yellow streaks; vertex and collar orange. Thorax fuscous with two whitish streaks on patagia. Abdomen above dark gray; venter white; legs gray with whitish streaks below. Fore wings fuscous brown; the veins, except on terminal third, whitish; a white streak along inner margin; a round white spot beyond cell. Hind wings white; outer margin broadly black; a narrow black streak along inner margin. Underneath as above.

Expanse, 27 mm.

Habitat.—Sao Paulo, Brazil.
Type.—Cat. No. 23553, U. S. N. M.

A NEW TRIGONALID FROM INDIA (HYM).

By T. D. A. Cockerell.

Some time ago Mr. Ramakrishna Ayyar sent me from India an insect which I took at first sight to be a bee of the genus *Nomada*. Closer inspection showed that the resemblance was wholly superficial, and I had before me a member of the Trigonalidae. I was not then able to do more than ascertain that it was at least closely allied to *Poecilogonalos thwaitesii* (Westwood), described from Ceylon. Coming to Washington, with the assistance of Mr. S. A. Rohwer and some additional literature, I have been able to separate it from all known forms, and it is accordingly described.

Poecilogonalos mimus, new species.

Female.—Length about 9 mm.; anterior wing 7.5 mm.; similar in general character and appearance to *P. thwaitesii,* but ground color of head and thorax mainly black, clypeus only very shallowly and broadly subemarginate, no median frontal spot, scutellum yellow with a median ferruginous band (axillae red), and second abdominal segment with the yellow confined to the broad apical band. The insect actually falls nearer to *P. formosana* Bischoff from Formosa, apparently agreeing in the rather coarse sculpture of the head and thorax, and in the clypeus being without a triangular emargination, as well as in the lack of the basal yellow spot on second abdominal segment. It differs, however, in the coloration of the scutellum, and in the dark cloud on the wings being confined to the apical half of the marginal cell (extending on the lower part as far as middle of third submarginal) and a broad area below the marginal beyond the third submarginal. The second submarginal cell is considerably longer than in Westwood's figure of *P. thwaitesii,* and the first recurrent nervure meets the first transversocubital, a trifle toward the outer side.

Head transverse, the broad mandibles yellow, with four black teeth; clypeus with two large subcircular yellow spots, separated by a reddish band; anterior and posterior orbits with broad yellow bands, the anterior one ending abruptly (broadly truncate) at about the beginning of the upper two-fifths of orbit; a pair of subtriangular yellow spots low down on front; scape swollen, ferruginous; flagellum long and slender, blackened above, below red with the sutures narrowly black; front with thin white hair; vertex closely punctured but shining; the posterior yellow band of cheeks, failing on occiput, emits two ferruginous bands which converge to top of eye, enclosing a black triangle, and below this is another black triangle behind the eye; thorax above rather coarsely punctured, the scutellum rugosopunctate and dull; sides and hind part of mesothorax ferruginous; the two wedge-shaped anterior yellow marks on mesothorax as in *P. thwaitesii;* postscutellum yellow with an oblique black band dividing the yellow on each side; lower part of metathorax broadly yellow; a curved yellow band on prothorax below tegulae, and another band on lower part of prothorax anteriorly; mesopleura with a round red spot below the wings, and an elongate yellow mark posteriorly lower down; metapleura with a slender yellow mark; coxae yellow, the hind pair only so posteriorly, otherwise black; trochanters pale yellowish; femora, tibiae and tarsi light ferruginous, the tarsi blackened on last joint; tegulae light ferruginous; wings clear, with dark piceous stigma and nervures, and cloud on anterior wings as already described; abdomen robust, finely punctured; first tergite with a large, somewhat T-shaped median yellow area, second with a very broad apical band, third ferruginous apically, with an obscure interrupted yellow band; the other segments mainly yellow with a median piceous band, as in *P. thwaitesii*; first sternite with a very broad yellow band, but the margin hyaline; second with a still broader band, interrupted in middle.

Pulney Hill, South India, 3–6,000 feet altitude, May 10–31 1917 (P. S. Nathan). Ramakrishna Ayyar No. 3.

Type.—Cat. No. 23451, U. S. N. M.

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PROCEEDINGS OF THE
ENTOMOLOGICAL SOCIETY OF WASHINGTON

VOL. 22 DECEMBER 1920 No. 9

NOTES ON THE PERIODICAL CICADA IN 1919.

BY RAYMOND A. ST. GEORGE, *Bureau of Entomology.*

Introduction.

The following events on the 1919 emergence of Brood X, of the Periodical cicada (*Tibicen septendecim* Linn.) were taken about Falls Church, Va., and vicinity.

Calendar of Events.

DATE.	CICADA EVENT.
April 24	Exit holes numerous in certain areas: nymphs in them six to eight inches from the surface; a few chimneys under logs.
May 14	First cast skin of season reported from Black Pond, Fairfax Co., Va., by Dr. A. C. Baker.
May 18	First adult at Falls Church, Va.
May 21	Approximately forty adults and skins on a dogwood tree.
May 22	First appearance of adults in numbers. First note of the cicada song heard on Minor's Hill.
May 23	Notes and song of adult more distinct.
May 24	Beginning of maximum emergence of nymphs at dusk.
May 25	Maximum volume of song. Continuous for first time all day. Nymphs emerged regularly at dusk by hundreds.
May 26–29	Nymphs emerged regularly at dusk by hundreds.
May 30	End of maximum emergence of nymphs; emerged about the same time at dusk from May 24–30th, incl.
May 31	Adults copulating and ovipositing.
June 1	Many adults dying from well known fungus disease.
June 4	Large species (*T. sept.*) and small variety (*T. sept.* var. *cassinii* Fisher) both singing.
June 5	Copulation period nearly over. Last day of maximum volume of song. First signs of cicada injury; leaves turning brown, twigs broken.
June 12	End of oviposition period. (Note by Dr. T. E. Snyder.) Adults beginning to disappear.
June 15	Concert only during hottest part of day.
June 17	Results of cicada injury very noticeable.
June 20	Adults nearly all gone. (Dr. T. E. Snyder.)

July 1	First day song not heard at all at Falls Church, Va.
July 1	Last cicada heard, note feeble. (Dr. T. E. Snyder.) Note from Washington, D. C.
July 16–20	First hatching of eggs from caged twigs.*
July 21–31	Nymphs emerged daily by hundreds.
Aug. 1	Nymphs decreasing in numbers.
Aug. 12	Last nymphs emerged from cages.

From the foregoing calendar of events the following periods, covering various phases of cicada activity, were determined.

LENGTH OF PERIODS.

EVENT	DATE	TO	DATE	TOTAL DAYS
Maximum nymph*	May 24		May 30	7
Maximum adult	May 22		June 20	30
Maximum volume of song, continuous concerts.	May 25		June 5	12
Copulation	May 31		June 7–9	8–10
Oviposition	May 31		June 12	13
Egg	May 31		July 16–20	47–51
Maximum emergence of nymphs from eggs.	July 21		Aug. 1	12
First to last adult	May 14		July 1	49
First to last song	May 22		July 1	42
First to last nymph	May 13		May 30	19
First to last nymph from eggs	July 16–20		Aug. 12	24–28

Relation of Temperature to Their Song.

To determine the relation between temperature and their song, records were taken from a hydrothermograph at the station for a period of ten days. During this time adults were most numerous and the notes most shrill.

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* The following insects were taken from cages containing twigs with cicada eggs in them. Although the exact relation they bear to the eggs was not fully determined, the occurrence seems worthy of note.

Pinkish thrips.

Dipterous larvae and adults, belonging to family Cecidomyidae. (Det. by Dr. J. M. Aldrich.)

Coleopterous adults, *Orthoperus glaber* Lec., a Corylophid. (Det. by E. A. Schwarz.)

Corrodentia,—one adult and three nymphs of a psocid. Det. by A. N. Caudell as *Peripsocus californicus* Banks.

The pinkish thrips are known to be predacious on the cicada eggs. Mr. Schwarz says that the coleopterous adults were probably feeding on a mold formed about the twigs where they had been injured through oviposition.

* "Maximum" = period of greatest abundance.

The results of these records show that the adults began to sing when the temperature ranged from 60–66° F. At no time did they sing when the temperature was below 60° F. During two successive nights when the temperature ranged from 62–74° F., it is believed that the concerts were continuous both nights. The writer was awake many times those nights and concerts of considerable volume could be heard, resembling those in the middle of the day. Both Dr. F. C. Craighead and Mr. S. A. Rohwer had similar experiences those nights, therefore, it seems probable that the song was continuous both nights. On the night of June third an attempt was made to start a concert by false alarm. About two o'clock a male was caught. It immediately began to sing. Upon being released it crawled away continuing to sing. The note aroused others about, and one by one it was taken up until the whole neighborhood seemed to be one continuous concert. This lasted about five minutes. Gradually the song subsided and all was quiet once again. The temperature at the time of the concert was 65° F.

Relation of Phenological Events in Plants and Cicada.

The relation of phenological events in plants and cicada may serve as an index as to when the various stages of cicada activity should appear. The following plant records were selected from those taken about Falls Church, Va., and vicinity by Mr. S. A. Rohwer and the writer. Trees representing the range for the species were selected when possible as well as those which were more common and widely distributed.

Phenological Table.

a—normal
Buds *b*—swelling
c—opening

d—unfolding
Leaves *e*—first full grown
f—falling

g—buds swelling
h—opening
i—first out
Flowers *j*—half out
k—full
l—fading
m—falling

n—out
Catkins *o*—flowers opening
p—pollen falling

CICADA EVENTS.		PLANT EVENTS.															
PHASE OF ACTIVITY.	NAME.	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*	*o*	*p*
Emergence holes numerous—nymphs in them 6-8 inches below surface.	*Cornus florida* (dogwood)				+			+	+	+	bracts all white						
	Prunus serotina (wild cherry)					+		+	catkins full length								
	Hicoria alba			+	+												
	Hicoria glabra			+	+												
	Juglans nigra (black walnut)				+	5–7 leaflets out											
	Quercus velutina (yel-oak)				+			catkins full length								+	+
First cast skin—from Black Pond, Fairfax Co. Va.—plant events earlier here than at Falls Church, Va.	*Chionanthus virginica* (fringe tree)										.	+					
	Robinia pseudacacia (black locust)									+							
	Viburnum dentata (viburnum)										+	+	+				
First adult at Falls Church, Va.	*Chionanthus vir.*									+	+						
	Juglans nigra											+					
	Liriodendron tulipifera (yellow poplar, tulip)									++	+	+					
	Prunus serotina												+	catkins			+
	Robinia pseuda.									+	+						
Adults in numbers—first notes.	*Castanea pumila* (chinquapin)							3–4 inches long							+		
	Cephalanthus occidentalis (button bush)											+					
	Juglans nigra										+	+					
	Robinia pseuda.											+	+				

		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*	*n*
Beginning of maximum emergence of nymphs.	*Ceanothus amer.* (Jersey tea)		+												
	Chionanthus vir.											+			
	Juglans nigra												+		
	Liriodendron tulip.											+			
	Prunus serotina												+	+	
	Sambucus racemosa (elder)		+	whitening—clusters opening											
	Viburnum dentata											+			
End of maximum emergence of nymphs. Adults copulating and ovipositing.	*Castanea dentata*							three inches long							+
	Chionanthus vir.													+	
	Cornus florida														
	Liriodendron tulip.										+		+	+	
	Viburnum dentata													+	
First signs of injury.	*Castanea pumila*								+						
	Ligustrum vulgare (privet)		+												
	Sambucus racemosa										+	+			
End of oviposition period.	*Ceanothus americana*										+	+			
	Diospyros virginana (persimmon)											+	+	+	
	Ligustrum vulgare										+	+			
	Sambucus racemosa												+		
Last adult note.	*Ceanothus am.*													+	
	Cephalanthus occiden.									+					
	Spiraea sp.		+												
Eggs hatching—first nymphs.	*Spiraea sp.*											+			
	Cephalanthus occiden												+	+	
	Hydrangea sp.							+							
Last nymphs.	*Hibiscus sp.*												+	+	

SYNONYMICAL NOTE IN AECOPHORIDAE. (Lep.)

BY CARL HEINRICH.

SANTUZZA KUWANII Heinrich — **ANCHONOMA XERAULA** Meyrick.

In a letter of May 4, 1920, Mr. Edward Meyrick informed me that my *Santuzza kuwanii*, described in an earlier number of this journal (Proc. Ent. Soc. Wash., Vol. 22, pp. 43–47, 1920), is a synonym of *Anchonoma xeraula* Meyrick (Bomb. Nat. Hist. Soc., Vol. 20, pp. 143–144, 1910). To enable him to pass with certainty on the identity of the two, since *S. kuwanii* was described from Japanese and *A. xeraula* from Indian and western Chinese material, I sent him a paratype of my species which he has since definitely determined as *A. xeraula*. Both the generic and the specific names (*Santuzza* and *kuwanii*) will therefore fall

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NEW SPECIES OF PERTHALYCRA AND OSMODERMA. (Col.)

H. F. WICKHAM, *Iowa City, Iowa*.

Perthalycra carolina, new species.

Oblong oval, moderately convex, above finely punctured and with subrecumbent pale pubescence, head and thorax shining, elytra less so. Color yellowish testaceous to castaneous, head darker, an ill-defined blackish discal spot sometimes present on each elytron. Head broad, punctuation moderately close and rather fine, sparser on the front which is flattened or a little concave, clypeus convex or tumid, separated from the front by a decided impression along the suture, anterior margin straight, the angles acute, labrum moderately deeply bilobed. Eyes prominent, rather small, coarsely granulate, hairy. Antennal club usually darker than the stem. Pronotum a little less than twice as wide as its median length, punctuation rather fine but very distinct, moderately close, scarcely more crowded laterally, sides beaded and fimbriate, moderately rounded, more rapidly convergent in front of the middle, all the angles strongly rounded, base slightly sinuate each side, broader than the apex and with a fine distinct marginal bead, apex broadly emarginate. Scutellum subtriangular, punctured, rounded at apex, about one-fourth wider than long and approximately one-seventh the length of the elytra. Elytra at base subequal in width to the thorax, conjointly very slightly narrowed and barely arcuate to about the middle, thence strongly rounded to their apices so as to form an obtuse reentrant angle at the suture. Punctuation fine, regularly disposed and without strial arrangement. Pygidium finely closely punctured and hairy. Body beneath finely punctured and pubescent. Legs punctured, moderately stout. Anterior tibiæ broad, apex sinuately subtruncate, bearing two short spines on its lower margin, outer margin finely crenulate, with a large apical tooth, the length of which is about equal to the adjacent tibial width and above which are two stout tooth-like spines. Spur long, curved, slender, blunt at apex. Middle tibiæ more slender, a little curved, somewhat expanded and sinuate towards the apex, spinose externally, spurs slender, the posterior one longer. Hind tibiæ similar. Length 3.75 mm., width, 1.90 mm.

Type and 2 paratypes in the United States National Museum, Type No. 23727, paratypes in the collection of the U. S. Biological Survey and of the author.

This species is described from eight specimens from Southern Pines, N. C. (type locality), collected with others under decaying fungus, Nov. 23, 1911, by Rev. A. H. Manee, and one specimen from Pensacola, Fla., collected Dec. 5, 1879 by E. A. Schwarz. These show some variation in color, as expressed by the description. The pubescence is easily abraded, some individuals being nearly naked above. The species has been distributed as *Perthalycra murrayi* Horn, which differs in being more coarsely punctured, especially on the pronotum, in the stronger fimbriation of the margin, and especially by the toothing of the front tibiæ. In *P. murrayi* the external prolongation of the tibia forms a bidentate process, while in *carolina* it is produced into a single long tooth. The crenulation of the outer margin of the fore tibia is more pronounced in *murrayi* and the spines near the middle are differently spaced. It would be interesting to know if the LeConte specimen from Georgia, mentioned by Dr. Horn in connection with the original description of *P. murrayi*, may possibly be *P. carolina*, since the two species have a strikingly similar superficial resemblance and seem to be absolutely congeneric in prosternal, antennal and other structural characters. The insect described by Blatchley as *Quadifrons castaneus*, from Florida, is very different in the structure of the front tibiæ which, from description, would seem more like those of Thalycra. In Quadrifrons the labrum is said to be rounded and not emarginate, while in both species of *Perthalycra* it is bilobed.

I am indebted to Mr. E. A. Schwarz for assistance in the way of suggestions and in giving me access to the specimens of *Perthalycra* and allied genera in the National Collection.

Osmoderma montana, new species

General form and luster similar to that of the same sex (female) of *O. eremicola*, but smaller, relatively more slender and with a more æneous tinge. In comparison with a female *O. eremicola* from Lone Rock, Wis., which was selected as representing a markedly northwestern locality, it is seen that *montana* has a shorter clypeo-frontal plate, the rugæ of the central part of which are transverse instead of concentric; the pronotum is slightly more narrowed behind, the median depression almost abruptly terminated at about the middle instead of being continued backwards as in *O. eremicola;* the surface of the pronotum has deep, rather variolose punctuation extending entirely across the disk behind the depression in place of the minute points seen in *O. eremicola;* and the scutellum, while of similar form, is more coarsely punctate, lacking the smooth median area. In *O. montana,* the elytra are rougher, the punctuation coarser, less regularly arranged in striæ near the suture; the pygidium is more elongate-triangular and less densely hairy. Body beneath, similar in the two species. Total length, 21.75 mm; elytron, along line of greatest length, 13.25 mm.: humeral width, across elytra, 9.25 mm.; greatest width, 10 mm. The corresponding measurements on the specimen of *O. eremicola* are 29.30, 17.20, 12.90 and 14 mm.

Type.—No. 23728, U. S. National Museum.

The holotype is a female collected by M. A. Hanna of the U. S. Biological Survey at a point 18 miles south of Dry Creek, Montana, southwest of Lismas in Valley County. It is now in the collection of the United States National Museum.

If the superficial characters set forth above were the only basis of separation, I should hardly care to give the Montana specimen a name, but dissection of the genitalia shows that they are different from those of the Wisconsin example of *O. eremicola.* The chitinized portions, in the female *Osmoderma*, are composed of a pair of broad, irregularly oval pieces, nearly flat-bottomed with reflexed margins, which may correspond to the "inferior plates" described and figured by Smith in his work on the genitalia of *Lachnosterna* (Proc. U. S. N. M., XI, 1888, p. 485, *et seq.*). These are similar in *O. eremicola* and *O. montana*, though not identical. Opposed to these plates are four other chitinous structures, the outer pair of which are probably the equivalent of Smith's "superior plates," while the inner are likely the representatives of what he calls the "pubic process." Comparison of these four pieces in the two species of *Osmoderma* under discussion shows that they are decidedly rougher and more deeply grooved in *O. montana.*

Incidentally, dissections were made of the male genitalia of the American *O. eremicola* and *scabra*, and of the European *O. eremita.* These are fully as characteristic in each instance as those of our species of *Lachnosterna* and would indicate the propriety of investigating these parts in describing new Scarabæidæ.

Acknowledgments are due to Messrs. Schwarz and Barber of the National Museum and McAtee of the Biological Survey, for facilitating the preceding studies.

ON THE IDENTITY OF SEVERAL SPECIES OF CHALCIDOIDEA (HYMENOPTERA).

By A. B. Gahan, *U. S. Bureau of Entomology.*

The following notes are presented for publication at this time in order to clear up the identity of the species in question before the references in literature become more complicated. The necessity for some of these changes is to be regretted as they involve the sinking of some rather well known names in synonymy, transferring of others, and the resurrection from synonymy of still others.

FAMILY CALLIMOMIDAE.

Eridontomerus isosomatis Riley.

Stictonotus isosomatis Riley, Rept. Ent. U. S. Dept. Agr., 1881–2, p. 186.
Stictonotus isosomatis Howard, U. S. Dept. Agr. Bur. Ent. Bull, 5, (old series) 1885, p. 45.
Merisus isosomatis Cresson, Syn. Hym. Amer. North of Mexico, 1887, p. 242.
Semiotellus isosomatis Dalla Torre, Cat. Hym., vol. 5, 1898, p. 211.
Eridontomerus primus Crawford, Journ. N. Y. Ent. Soc., vol. 15, 1907, p. 179.
Merisus isosomatis Viereck's Hym. Conn., Bull. 22, Conn. Sta. Geol. and Nat. Hist. Surv., vol. 3, 1916, p. 478 (description).

While attempting to determine some parasitic material recently the writer found it necessary to consult the original description of *Stictonotus isosomatis* Riley. Upon reading the description he was at once impressed with its failure to coincide with the conception of that species current in literature. The description is of an insect with metallic front femora, black median and hind femora, black hind tibiae, and a metallic colored abdomen whereas the species going by that name in the literature has a bright yellow abdomen and yellow legs. An attempt to verify the description by means of the type developed further complications. A single specimen bearing the name and recorded in the type catalog as type of the species was located in the collection of the United States National Museum. The data on the pin and in the type catalog showed this specimen to have been reared by F. M. Webster from Isosoma, February 5, 1885. Since *Stictonotus isosomatis* Riley was described in 1882 from specimens said to have been reared from material received from J. K. P. Wallace of Tennessee, it was at once apparent that the specimen in question could not be Riley's type. Furthermore, this specimen did not correspond to Riley's description nor was it the *Stictonotus isosomatis* of authors, it being instead a female of *Merisus destructor* Say. Search for the true type was finally rewarded by the finding of two pins, one bearing a female mounted on a card point, the other bearing two males similarly mounted. Both pins bore the old style Division of Entomology breeding number 2246° and in addition a name label in L. O. Howard's handwriting. Upon consulting the records under the number 2246° in the Bureau of Entomology, it was positively determined that the three specimens in question were reared in May 1881 from material received from Mr. J. K. P. Wallace of Andersonville, Tennessee. This data checks exactly with that given by Riley for his types and since the specimens agree in every way with the original description there can be no doubt that they are actually the specimens from which the description was drawn.[1] As represented by these types, *Stictonotus isosomatis* Riley is identical with the Callimomid, *Eridontomerus primus* Crawford. Riley's description antedates that by Crawford and the species will, therefore, have to be known in the future as *Eridontomerus isosomatis* Riley.

How the identity of this species became so confused it is impossible to say. The fact remains that the insect which has been repeatedly referred to under the name of *isosomatis* by Webster, Kelly, and others, and which has been placed at different times in the genera, *Stictonotus*, *Merisus*, and *Semiotellus* is an entirely different species from that to which Riley gave the name. (See *Merisus febriculosus*, p. 238 seq.).

Eridontomerus isosomatis is, so far as present records show, exclusively parasitic in the species of (Isosoma) Harmolita, or joint worm flies, and probably occurs from coast to coast of the United States.

The record in Viereck's Hymenoptera of Connecticut cited above consists of a quotation of Riley's original description coupled with records of occurrence of the species in Connecticut. It is more than likely that the Connecticut breeding records there set forth really refer to *Merisus febriculosus* Girault.

Ditropinotus aureoviridis Crawford.

Ditropinotus flavicoxus Gahan, Proc. Ent. Soc. Wash., 14, 1912, p. 5.

The females of this species are evidently quite variable in color. Types of *aureoviridis*, of which there are eight female specimens in the series, have the entire thorax as well as the middle and hind coxae except apically metallic green, and the abdomen dorsally brown. There is some variation in the extent of the metallic coloration of the coxae, some specimens having them metallic only basally. The type series of *flavicoxus*, on the other hand, which includes eight females, shows the underside of almost the whole thorax from the tegulae downward, all coxae, and in some specimens the whole propodeum honey-yellow while the abdomen above and below is similarly colored. The mesosternum is more or less metallic. These colorational differences were so striking that the writer had little hesitancy in describing *flavicoxus* as a new species especially since they appeared to be confirmed by two or three very slight sculptural differences. Acquisition of additional material, largely reared has, however, demonstrated that there is almost a perfect gradation in color from the one form to the other. I am now convinced that both forms represent the same species, the two type series probably representing the extremes of variation.

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[1] Dr. L. O. Howard informs me that he drafted the original description of *Stictonotus isosomatis* for Professor Riley, and he confirms my identification of the type specimens.

Websterellus harrisi Fitch.

Torymus (sp.) Harris, Rept. on Ins. Inj. to Veg., 1852, p. 442–3 (2nd ed.).

Torymus harrisii Fitch, 7th Rept. Ins. N. Y., 1862, p. 152–3.

Torymus (sp.) Harris, Ins. Inj. to Veg., 1863, p. 556 (Flint ed.).

Websterellus tritici Ashmead, Bull. Ohio Agr. Exp. Sta., 1, 1893, p. 164; Pl. II, figs. 1 and 2; Pl. III, figs. 3–4.

Cryptopristus americanus Girault, Descriptiones Stellarum Novarum, 1917, p. 8.

Fitch's types of this species are apparently lost. At least the writer has failed to locate them in the Fitch collection, or elsewhere in the National Museum.

The description by Fitch, supplemented by that of Harris, agrees in every way with *Websterellus tritici* Ashmead except that the abdomen of *tritici*, when viewed through a binocular microscope, is seen to be rather distinctly reticulately sculptured instead of smooth and polished as stated by Harris. Viewed through a hand lens, however, this sculpture is practically invisible and the whole abdomen has a distinctly shining appearance. Since the description by Harris was undoubtedly drawn with the aid of a hand lens the apparent discrepancy between the description and the type of *tritici* is thus explained. No other parasite upon joint-worms at present known in America, could by any possibility be Fitch's species, and in view of the very satisfactory agreement the writer has no hesitation in declaring *tritici* Ashmead a synonym of *harrisi* Fitch. The species is type of the genus *Websterellus*.

Cryptopristus americanus Girault was described from one female specimen reared from (Isosoma) Harmolita at Wellington, Kansas, by E. G. Kelly. The type has been compared with the types of *tritici* and agrees in every essential detail.

Harris' and Fitch's specimens were from Virginia; the types of *tritici* from Wooster, Ohio; the type of *americana* from Kansas. This comprises the distribution of the species as known at the present time.

FAMILY ENCYRTIDAE.

Eupelmus allynii French.

Pteromalus (sp.) Harris, Ins. Inj. Veg., 1863, p. 556 (Flint edition).

The description by Harris cited above fits exactly the male of *allynii* and agrees with no other known parasite of the joint worm flies (Harmolita). Since Harris did not name the species, the validity of French's name is not affected and the reference is chiefly interesting as constituting a much earlier record of the species in literature.

FAMILY PTEROMALIDAE.

Merisus febriculosus Girault.

(= *Stictonotus isosomatis Authors not Riley*)

Merisus isosomatis Webster, Ins. Life, vol. 5, 1893, p. 90.
Stictonotus isosomatis Webster, U. S. Dept. Agr. Bur. Ent. Bull. 42 (new ser.) 1903, p. 22.
Merisus isosomatis Webster, l. c., p. 33.
Stictonotus isosomatis Webster, Proc. Ent. Soc. Wash., vol. 7, 1905, p. 115.
Stictonotus isosomatis Webster, U. S. Dept. Agr. Bur. Ent. Circ. 66, 1908, p. 4.
Semiotellus isosomatis Webster and Reeves, U. S. Dept. Agr. Bur. Ent. Circ., 106, 1909, pp. 8, 9, fig. 11.
Stictonotus isosomatis Kelly, Journ. Econ. Ent., vol. 3, 1910, p. 202.
Merisus isosomatis Crawford, in Smith's Ins. of New Jersey, 1910, p. 642.
Merisus isosomatis Viereck, Hym. Conn., Bull. 22, Conn. Sta. Geol. Nat. Hist. Surv., vol. 3, 1917, p. 478 (rearing record).
Merisus febriculosus Girault, Descriptiones Stellarum Novarum, 1917, p. 17.

As pointed out in the discussion of *Eridontomerus isosomatis* (ante p. 235) the *Merisus isosomatis* of authors is not *Stictonotus isosomatis* Riley. Luckily it is not necessary to propose a new name for *isosomatis* Riley however, as one is already available in *Merisus febriculosus* Girault. The type material of *febriculosus* consists of a single female from Wooster, Ohio. This specimen was without much doubt collected by Webster although not so labelled. It is identical with numerous other specimens in the collection reared by Webster from joint worm material in Indiana, Michigan, and Ohio, and which form the bases for the several notes published by him.

Whether or not Girault was aware of the fact that *Merisus febriculosus* was identical with the *isosomatis* of authors (not Riley) does not appear. He makes no statement to that effect either with the original description or elsewhere.

This species is a common parasite of various species of Harmolita as shown by the published records cited above as well as numerous unpublished records in the files of the Bureau of Entomology. It also occurs as a parasite of the Hessian fly, *Mayetiola destructor*, according to a number of trustworthy rearing records of the Bureau as yet unpublished. In distribution it ranges at least from Maryland to Kansas, as shown by specimens at hand, and it will probably eventually be found to occur over the whole of the United States and Canada where wheat is subject to the attacks of the joint worms and Hessian fly.

Aplastomorpha vandinei Tucker.

Meraporus vandinei Tucker, Can. Ent., vol. 42, 1910, p. 343.
Aplastomorpha pratti Crawford, Proc. U. S. Nat. Mus., vol. 47, 1913, p. 252.
Neocatolaccus australiensis Girault, Mem. Queensl. Mus., vol. 2, 1913, p. 306.
Aplastomorpha australiensis Girault, Mem. Queensl. Mus., vol. 3, 1915, p. 313.

Girault has already stated the above synonymy (Ins. Ins. Mens., 5, 1917, p. 152) but without indicating definitely to what genus the species should be referred. The writer has compared types of *vandinei* and *pratti*. The synonymy of *australiensis* is accepted on authority of Girault.

The genera *Aplastomorpha* Crawford, *Neocatolaccus* Ashmead, and *Zatropis* Crawford are much alike and may eventually have to be synonymized. *Aplastomorpha* may be separated from both the others, however, by the almost total absence of appressed hairs on the thorax and by the fact that the antennae are inserted lower down being distinctly below the middle of face.

Lariophagus distinguendus Foerster.

Pteromalus distinguendus Foerster, Beitr. Monogr. Pteromal., 1841, p. 17, No. 84.
Meraporus calandrae Howard, Rept. Ent., U. S. Dept. Agr., 1880–1881, p. 273.
Meraporus utibilis Tucker, Can. Ent., vol. 42, 1910, p. 341.
Lariophagus distinguendus Kurdjumov, Rev. Russ. Ent., 13, 1913, p. 15.
Lariophagus distinguendus Hase, Sitz. d. Ges. Naturf. Freunde, Berlin, 1919, p. 402.

The above cited publication by Hase gives a very exhaustive account of this cosmopolitan parasite of *Calandra oryzae* and other stored grain pests. *Meraporus utibilis* Tucker is listed as a synonym by Hase.

Previous to receipt of Hase's paper the writer had compared the types of *utibilis* and *calandrae* and had arrived at the conclusion that they were the same species. The type of *utibilis* is a rather small and poorly developed specimen. The national collection contains a series of specimens taken at quarantine, Washington, D. C., in a shipment of grain from Italy and determined by J. C. Crawford as *distinguendus* Foerster. Comparison of these specimens with Hase's description leaves no doubt as to the correctness of the determination. They also agree in every way with the Howard and Tucker types.

Eupteromalus sarcophagae Gahan.

In the Bulletin of the Brooklyn Entomological Society vol. 12, 1917, p. 118, Mr. A. A. Girault asserts that this species differs "not at all" from *Meraporus dubius* Ashmead.

Types of both species are in the U. S. National Museum and have been compared with the following results:

The postocellar line practically equal to the ocellocular line; malar groove absent; face below the antennae when viewed in profile convexly rounded, distinctly receding, vertex broad, not sharply sloping behind the ocelli; viewed from in front the vertex is very slightly arched above the eyes, the frons deeply, closely sculptured especially in the frontal depression and there are no transverse aciculations on the face below the antennae; the scutellum is convex, or at least not conspicuously flattened, and its apical margin is more weakly sculptured than the remainder *sarcophagae* Gahan

Postocellar line distinctly though not a great deal longer than the ocellocular line; malar groove present; face below antennae not so convexly rounded and less receding, vertex not so broad and more sharply sloping behind ocelli; viewed from in front the vertex is more strongly arched above the eyes, the frons is very slightly less deeply punctate and immediately below the base of the antennae are two or three short, very fine, weak, transverse, wrinkles or rugae; the scutellum is distinctly flattened with a narrow transverse apical margin very distinctly more coarsely punctate than the rest of the scutellum *dubius* Ashmead

The two species are undoubtedly congeneric and closely related, but are sufficiently distinct to be recognized as different species, at least until additional material and rearing data establish their identity.

Eupteromalus viridescens Walsh.

Glyphe viridascens Walsh, Trans. Ill. Agr. Soc., 1861, pp. 264 and 370.
Glyphe viridescens Packard, 6th Ann. Rept. Me. Bd. Agr., 1861, p. 6.
Glyphe viridescens Walsh, Trans. Ill. Agr. Soc., 1865, pp. 11 and 483.
Glyphe viridascens Riley, 2nd Ann. Rept. Ins. Missouri, 1870, p. 53, fig. 24.
Glyphe viridascens Riley, 8th Ann. Rept. Ins. Missouri, 1876, p. 53.
Glyphe viridascens Packard, 9th Rept. U. S. Geol. Surv., 1877, p. 706.
Glyphe viridascens Riley, Trans. Ac. Sci. St. Louis, 4, 1881, p. 302 (in part).
Glyphe viridascens Riley, 3rd Rept. U. S. Ent. Comm., 1883, p. 127 (in part).
Glyphe viridascens Riley, Ins. Life, 5, 1892, p. 138.
Glyphe viridascens Lintner, 12th Rept. Ins. New York, 1897, p. 210.
Gastrancistrus viridescens Dalla Torre, Cat. Hym., 5, 1898, p. 205.
Hypopteromalus viridescens Girault, Bull. Wisc. Nat. Hist. Soc., 10, 1912, pp. 24–46 (in part).

This species and (*Pteromalus*) *Hypopteromalus tabacum* Fitch were declared to be the same species by Riley (1881, 1883) and later by Girault (1912).

Unfortunately the types of Walsh's species are lost. The national collection contains specimens, however, reared from the army-worm in August, 1875, apparently by Riley, and labelled in Riley's hand "*Glyphe viridascens* Walsh." These specimens are erroneously labelled types. They cannot be the actual Walsh types since the rearing date is some thirteen years subsequent to publication of the description. They do fit Walsh's description perfectly however, and are undoubtedly representatives of the species to which he gave the name *Glyphe viridescens*.

Types of *Hypopteromalus tabacum* Fitch are in the national collection in a fair state of preservation. They disagree in several important particulars with Walsh's description of *viridescens*. According to Walsh *viridescens* is 0.07 of an inch in length, dark green, verging on black in color, the abdomen black. Fitch's *tabacum*, on the other hand, as shown by the types, averages 2.5 mm. in length, is bright blue-green in color with little or no suggestion of blackish on head and thorax, the abdomen more or less blackish in some lights but for the most part highly polished blue-green. There are other slight points of disagreement, but those pointed out are sufficient to demonstrate that what Walsh was describing was not the *tabacum* of Fitch.

If the foregoing conclusion regarding the identity of *viridescens* is correct then it and *tabacum* are not congeneric. The former species has the head, viewed from in front distinctly broader than long, the occiput distinctly margined, the scutellum broad and flattened dorsally, and the abdomen sessile as that term is used in the Pteromalidae. It belongs in the genus *Eupteromalus* Kurdjumov.

The species *tabacum* which is type of the genus *Hypoptermalus* has the head viewed from in front nearly circular the vertex strongly arched above the eyes, the occiput entirely immargined, the scutellum convexly rounded above and the abdomen distinctly petiolate. Until the Pteromalidae undergo a thorough revision the genus *Hypopteromalus* should be retained.

Hypopteromalus tabacum Fitch.

Pteromalus tabacum Fitch, Trans. N. Y. Agr. Soc., 23, 1863, p. 792.
Pteromalus tabacum Fitch, 6th-9th Rept. Ins. New York, 1865, p. 225.
Glyphe viridascens Riley, Trans. Ac. Sci. St. Louis, 1881, p. 302 (in part).
Glyphe viridascens Riley, 3rd Rept. U. S. Ent. Comm., 1883, p. 127 (in part).
Aetroxys tabacum Garman, 3rd Rept. Ky. Exp. Sta., 1890, pp. 35 and 36.
Hypopteromalus tabacum Garman, Kentucky Agr. Exp. Sta., Bull. 66, 1897, p. 28.

Pteromalus tabacum Dalla Torre, Cat. Hym., 5, 1898, p. 150.

Hypopteromalus tabacum Dimmock, Proc. Ent. Soc. Wash., 4, 1898, pp. 149–150.

Hypopteromalus tabacum Ashmead, Smith's Ins. N. Y., 1900, p. 643.

Hypopteromalus tabacum Ashmead, Mem. Carn. Mus., 1, 1904, pp. 320 and 378.

Hypopteromalus tabacum Nason, Ent. News, 17, 1906, p. 152.

Hypopteromalus tabacum Howard and Chittenden, U. S. Bur. Ent. Circ., 96, 1907, p. 5.

Hypopteromalus tabacum Crawford, U. S. Bur. Ent. Techn. Bull., 19, 1910, p. 21.

Hypopteromalus viridescens Girault, Bull. Wisc. Nat. Hist. Soc., 10, 1912, pp. 24–46 (in part).

Hypopteromalus viridescens Webster, Proc. Iowa Acad. Sci., 19, 1912, p. 209.

Hypopteromalus viridiscens Webster, Iowa Agr. Exp. Sta., Bull. 155, 1915, p. 388.

Hypopteromalus tabacum Viereck, Conn. Geol. Nat. Hist. Surv., Bull. 22, 1917, p. 474.

The above citations to literature are all believed to refer to this species. The record by Viereck of this species as a parasite of *Calandra oryzae* is undoubtedly erroneous as it is exclusively a secondary parasite issuing from the cocoons of various species of *Apanteles* and possibly other Ichneumonoidea. (See discussion under *Eupteromalus viridescens*, ante).

FAMILY EULOPHIDAE.

Genus **Ceratoneura** Ashmead.

Ceratoneura Ashmead, Journ. Linn. Soc. Lond. Zool., 25, 1894, p. 178.

Ceratotetrastichodes Girault, Speciosissima Genera Nova Eulophidarum, Washington, D. C., 1917, p. 2.

In describing *Ceratotetrastichodes* which he bases upon the species *Ceratoneura pretiosa* Gahan, Girault states that this "may not be a genus at all." The writer is of the opinion that this statement is fully warranted. Girault bases the genus entirely upon antennal characters. As shown by the following notes the antenna of *C. pretiosa* does not differ in any essential detail from that of *C. petiolata* Ashmead, genotype of *Ceratoneura*. Neither do the two species differ otherwise in any characters worthy of generic rank and Girault's genus must therefore be considered a synonym.

Ceratoneura pretiosa Gahan.

Ceratoneura pretiosa Gahan, Proc. U. S. Nat. Mus., 48, 1914, p. 165.

Ceratotetrastichodes pretiosa Girault, Speciosissima Genera Nova Eulophidarum, Washington, D. C., 1917, p. 2.

In attempting to correct the description of this species, admittedly incorrect in some respects, Girault has himself erred. A careful examination of slide mounts of the antennae from paratype specimens of both sexes shows the following to be the facts: The female antennae have four ring-joints, three funicle joints and a three jointed club; the first three ring-joints are very small transverse and closely jointed together so that in a dry mounted specimen they appear as one very small joint; the fourth ring-joint is subquadrate, being considerably larger than the three preceding ring-joints combined; the funicle joints are as indicated in the original description; the club is about equal in length to the two preceding funicle joints, the three joints distinct in a balsam mounted specimen but not well separated, the sutures consisting of mere shallow grooves. The male antennae have three small transverse ring-joints (not four as stated by Girault). The funicle appears to be 5-jointed and the club 2-jointed, the funicle joints each with a whorl of long hairs. In the original description the statement was made that "the funicle is really but 3-jointed, the first ring-joint being greatly elongate and the basal joint of the club resembling the funicle joints." This statement is wrong since it is the last ring-joint, not the first, which is elongate. The apparent fifth funicle joint is believed to be merely the basal joint of club more than usually detached and modified to resemble a funicle joint. Only in this manner can the antennae of the male and female be homologized.

Ceratoneura petiolata Ashmead.

Examination of a slide mount of the female antenna of this species shows it to have apparently four ring-joints similar to those in *pretiosa*, *viz.*, the first three short and transverse while the fourth is large and subquadrate; the three basal ring-joints are even more closely joined and indistinct than in *pretiosa;* the funicle consists of three subequal joints each approximately one and one-half times as long as thick, the middle joint very slightly the longest in the specimen examined; the club is shorter than the two preceding funicle joints combined, indistinctly 3-jointed, the sutures, especially the last, very indistinct. The male funicle is 5-jointed and club 2-jointed; first funicle joint only slightly longer than broad and much shorter than the second which is fully twice as long as thick; following joints of funicle decreasing slightly in length toward the apex; club shorter than the two preceding funicle joints combined, its first joint much longer than the second, all funicle joints with a basal whorl of long hairs.

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